

CALFED
BAY-DELTA
PROGRAM

Restoration Coordination Program 1999 Projects Recommended for Funding

- Executive Summaries for 1999 PSP Proposals Recommended for Funding
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Fish Passage/Fish Screens Recommended For Funding

Prop. No.	Project Title	Applicant Organization	Recommended Amt.
99-A105	Fish Passage Improvement Project at the Red Bluff Diversion Dam	Tehama-Colusa Canal Authority	\$1,000,000.00
99-A109	Fish Treadmill Developed Fish Screen Criteria for Native Sacramento-San Joaquin Watershed Fishes	Wildlife, Fish, & Conservation Biology, UC Davis	\$1,036,821.00
99-A117	Improve the Upstream Ladder & Barrier Weir @ Coleman Nat'l Fish Hatch. in Battle Creek	US Fish & Wildlife Service	\$1,663,400.00

Executive Summary

Project Size and Location

The project is located on the main stem of the Sacramento River at the upper end of the Butte and Colusa Basin Watersheds in Tehama County. Figure 1 shows the Red Bluff Diversion Dam (RBDD) and the current Tehama-Colusa Canal Authority (TCCA) intake site. Figure 2 shows the TCCA service area and the reach of the Sacramento River being investigated for potential pump station sites.

Project Description and Primary Biological/Ecological Objectives

This proposal is for Phase II of a project that involves modifying the RBDD or its operations to reduce or minimize the impacts of the RBDD on upstream and downstream migration of juvenile and adult anadromous fish, while improving the reliability of agricultural water supply. The potential alternatives range from developing a completely new screened intake to the Tehama-Colusa (T-C) and Corning canals (Canals) and entirely eliminating the need for the RBDD for agricultural irrigation to devising a new operating schedule for the RBDD, incorporating existing pumping facilities, and constructing minor additional facilities, or a combination of these elements. Phase I, partly funded by a 1998 CALFED Category III grant and currently in progress, is a feasibility study to preliminarily identify alternative facility operations and sites, land requirements and ownership, environmental and other regulatory requirements, design criteria, costs, and potential funding sources to implement the project.

Phase II will include preliminary design for alternatives identified, screened, and found feasible in Phase I; environmental review; and completion of an implementation plan. The environmental review will be conducted on several feasible alternatives to meet both National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) requirements. The implementation plan begun in Phase I will be expanded, refined, and finalized as the location, configuration, scope, and cost of the project becomes more clearly defined. The implementation plan will address financing, construction scheduling, and permitting requirements and will include a monitoring plan.

The primary biological/ecological objectives of the project are to reduce or minimize the impacts of the RBDD on upstream and downstream juvenile and adult anadromous fish migration. The RBDD, as it currently operates, is a barrier to anadromous fish migration from May 15 through September 15 when its gates are closed and obstruct normal river flows. Reducing or eliminating the current dependence on the RBDD for agricultural irrigation supply would enable RBDD operations to be modified to improve fish passage for all adult and juvenile anadromous fish.

Project Cost

The amount requested from CALFED is \$2,574,000. The TCCA would administer the project with input from resource agency staff who are involved with RBDD fish passage issues. These agencies, which have representatives on the Red Bluff Fish Passage Study Management Group (SMG), include Reclamation, USFWS, NMFS, CDFG, DWR, and TCCA. These entities will participate as part of their funded, ongoing efforts. These costs are not included in the amount requested from CALFED for Phase II. TCCA's costs to administer Phase II of the project, \$139,000, are included in Table 2b of this proposal to show total estimated project cost. However, TCCA will bear these administrative costs, and these costs also are not included in the amount requested from CALFED.

Adverse and Third Party Impacts

Third party impacts might occur due to project implementation. Potential project environmental and socioeconomic impacts would be mitigated under NEPA and CEQA requirements to the extent feasible. Third parties also might realize significant project benefits, as described below.

Applicant Qualifications

The TCCA is a joint powers authority formed approximately 12 years ago to improve maintenance procedures on the T-C and Corning canals. TCCA, with a staff of 22 full-time employees, currently operates and maintains 140 miles of canals, mostly concrete-lined, with an annual budget of more than \$2 million. TCCA has significant experience administering water supply capital improvement projects. TCCA partners with Reclamation in operating the RBDD and addressing associated fisheries issues. TCCA participates in public forums and technical groups doing RBDD fisheries research and makes significant financial and technical contributions to such efforts. Through its Joint Powers Agreement, TCCA has the authority to acquire, construct, manage, maintain, and operate major facilities.

Monitoring and Data Evaluation

This proposal outlines a monitoring program that will be further developed in this phase and implemented with the proposed project. It identifies hypotheses regarding fish passage at the RBDD, biological/ecological objectives, monitoring parameters and data collection approach, and data evaluation approach. The monitoring program incorporates existing RBDD fish passage data and will use ongoing monitoring data to evaluate the effectiveness of the project in improving fish passage at this locality.

Local Support/Coordination with other Programs/Compatibility with CALFED Objectives

This project was authorized by the unanimous vote of the TCCA Board of Directors on May 12, 1998. TCCA member districts serve agricultural areas in Tehama, Glenn, Colusa, and Yolo counties. The proposed project has the interest and support of the Red Bluff Fish Passage SMG, which will be given periodic progress reports, along with requests to review and provide information, as appropriate. Agencies that have expressed support for the project goals and objectives and indicated a desire to participate in the project's development include Reclamation, USFWS, NMFS, CDFG, and DWR.

The proposed project is compatible with the CALFED Bay-Delta Program, Biological Opinion for Operation of the RBDD, RBDD Research Pumping Plant evaluation project, RBDD Long-term Fish Passage Program, Draft Winter-run Salmon Recovery Plan, Central Valley Project Improvement Act (CVPIA) through the Anadromous Fish Restoration Program (AFRP), and the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act of 1988.

The project also is compatible with CALFED ecological restoration targets and programmatic actions identified for "Dams and Other Structures" in CALFED's February 1999 ERP, Volume 2, page 190. Specifically, this project addresses Target 1: "Minimize survival problems for adult and juvenile anadromous fish at RBDD by permanently raising the gates during the non-irrigation season and improving passage facilities during the irrigation season" and Programmatic Action 1A: "Upgrade fish passage facilities at the RBDD." The project supports the CALFED non-ecological objective of providing a more reliable water supply for agriculture and other beneficial uses, such as wildlife refuges.

FISH TREADMILL-DEVELOPED FISH SCREEN CRITERIA FOR NATIVE SACRAMENTO-SAN JOAQUIN WATERSHED FISHES

II. EXECUTIVE SUMMARY

The Fish Treadmill Project is an ongoing, multi-agency research effort to quantitatively evaluate the performance and behavior of small Delta and upstream fishes in multi-vector flows near fish screens for the purpose of developing fish screen design, flow, and operational criteria that reduce adverse impacts of water diversions on these species. This proposal requests funding from CALFED to continue the project for a period of 13.5 months (August 16, 1999-September 30, 2000) in order to complete ongoing experiments with delta smelt, splittail and chinook salmon, and to conduct experiments with steelhead trout and other priority species.

Installation of fish screens and improvements to existing fish screen facilities have been identified by CALFED as activities that provide direct benefits to fish resources, habitats, and ecosystem processes by reducing stressors associated with water diversions (ERPP, Vol. 1, p. 425). However, present fish screen criteria are based on limited data from (usually) unrealistic flume studies with salmonids and non-native fishes (e.g., the delta smelt criterion is based on data from American shad). For many native fishes of the Sacramento-San Joaquin system, including listed species like delta smelt and splittail, these criteria may be inadequate and confer no protection from entrainment and impingement, or overly protective and thus unnecessarily costly to water diverters. The Fish Treadmill project was specifically proposed and designed by cooperative, multi-agency partners to address these information gaps for priority native fishes and to provide timely, relevant, and comprehensive data that could be applied to design, operate, and adaptively manage screened water diversions that more effectively protect Sacramento-San Joaquin watershed fish resources.

The Fish Treadmill is a large circular flume equipped with a fish screen, uniquely capable of testing small, delicate fishes like delta smelt in a wide range of independently controlled approach and sweeping velocities. The apparatus is operational, calibrated for a wide range of flows, and staffed with highly qualified personnel. The biological study plan and quality control/assurance plan, developed through rigorous multi-agency discussion, review and pilot studies, have been approved by the existing contract Quality Assurance Officer (K. Bates, consultant to DWR) and members of the quarterly review panel (DWR, DFG, NMFS, USFWS). Unlike field-based studies at large fish screen facilities (e.g., Tracy Fish Facility), the Fish Treadmill allows detailed, quantitative observations on fish performance (e.g., impingement, survival, injury, stress) and behavior (e.g., swimming velocity, velocity past screen) under controlled flow and environmental (e.g., temperature) conditions during the day (light conditions) and night (dark conditions). For each species, results of experiments will be applied to determine optimal screen flow conditions that minimize impingement, screen exposure duration, and mortality. Comparisons among and between species, size classes, environmental conditions, and time of day will provide data for development of adaptive management strategies for screened water diversions.

The Fish Treadmill project is ongoing and presently funded exclusively by DWR. To date (1.5 years into a planned three-year biological study program), experiments have been conducted with delta smelt (approximately 40% complete), splittail (approximately 80% complete), and chinook salmon (approximately 70% complete). This proposal requests funding from CALFED

for the remainder of the planned research program in order to complete these experiments and to conduct experiments with steelhead trout and other priority species. The Fish Treadmill project should be funded by CALFED for several reasons. It addresses a major stressor, water diversions, and is specifically designed to produce the scientific information necessary for CALFED to reduce the adverse impacts of the stressor by installation of protective fish screens. Results of this project will provide benefit to 11 of the 14 Ecological Management Zones defined by CALFED (most located in the Bay/Delta and mainstem rivers) and to virtually all of the highest priority fish species (delta smelt, splittail, chinook salmon, steelhead trout). For example, in the Sacramento-San Joaquin Delta Ecological Management Zone, reduction of entrainment and impingement losses of fish at water diversions is identified as a target, with replacement/upgrades of the SWP, CVP, and PG&E screens identified as specific programmatic actions (ERPP, Vol. 2, p. 110). For protection of fishes like delta smelt and splittail, results of the Fish Treadmill project will be very useful in developing design and operational criteria for these new/upgraded fish screens. By developing the data and technology to reduce water diversion impacts, the project has links to other ecosystem elements and CALFED goals, including native species recovery and conservation (CALFED Goal 1), improving recreational and commercial fisheries (CALFED Goal 3), and rehabilitation and protection of natural processes (CALFED Goal 2), successful implementation of the CVPIA and of recovery measures for ESA listed species, and non-ecosystem benefits like water supply reliability. Continuation and completion of the Fish Treadmill project has multi-agency support, including CALFED (ERPP, Vol. 1, p. 428-429), DWR, DFG, USBR, NMFS, and USFWS.

CALFED funding is requested to support the operation of the Fish Treadmill (UCD Hydraulics Laboratory), implementation of the biological studies (UCD Fish Physiology Group), and DFG assistance for fish collection and participation in the experiments. DWR has agreed to share costs by providing funding to support one scientific aide for assistance with the biological studies. Cost of the project depends on funding source: \$823,000 if funded through a State agency and \$1,036,821 if funded through a federal agency. There are no adverse or third party impacts of this project.

The principal investigator, Dr. Joseph J. Cech, Jr., is presently the co-principal investigator for the ongoing Fish Treadmill biological studies. All other staff, including co-principal investigator Dr. M. L. Kavvas (supervisor for Fish Treadmill operation and hydraulic studies), and co-investigators Drs. Christina Swanson and Paciencia S. Young (managing biologists for the Fish Treadmill biological studies), Dr. Z. Q. Chen (managing engineer for Fish Treadmill operation and hydraulic studies), and Robert Fujimura (DFG, interagency liaison and fish collection supervisor) participated in the development of the Fish Treadmill project and are presently actively involved in the program.

EXECUTIVE SUMMARY

A technical subcommittee of the Battle Creek Working Group (BCWG) identified two improvements to correct the deficiencies in the existing Coleman National Fish Hatchery (CNFH) barrier weir -- the need to improve the barrier weir's capability of **effectively blocking hatchery-origin fall chinook** from swimming-over the weir and the need for an **improved fish ladder**. We need to manage passage above the barrier weir to prevent hybridization of spring and fall run chinook, avoid possible redd superimposition and overutilization of rearing habitat (Figure 1).

Blocking fish passage is not usually the first action undertaken by biologists working on a fishery restoration program, yet since Battle Creek is home to the major mitigation feature for Shasta Dam -- the hatchery, blocking or managing passage of salmonids is of primary importance. In the case of Battle Creek, large numbers of returning, hatchery-origin, fall chinook salmon often exceed the broodstock needs at the hatchery. We know that some fall chinook are accessing the upper watershed (USFWS 1998a) and our concern is that some of these fall run chinook salmon (i.e. migrating July through December) could be hybridizing with spring run chinook (i.e. migrating mid February through July, but holding over to spawn in August through October (CDFG 1998a)). Other concerns include the possibility of redd superimposition or exceeding the biological carrying capacity of the habitat available in Battle Creek -- if large numbers of excess fall run, hatchery-origin chinook are able to access habitat upstream of the hatchery (Figure 2).

Although the weir is integral to broodstock collection at CNFH (located at stream mile 6.0), it is the first in a series of 7 passage impediments that affect all fish returning to over 40 miles of prime salmonid spawning and rearing habitat. The recent "agreement in principle" with PG&E, resource agencies and stakeholders to alter the hydropower system (i.e. dismantling dams, improving passage, increasing flows) is paving the way for additional restoration actions to insure that all 40+ miles of habitat in Battle Creek are accessible to salmon and steelhead. Therefore, it is critical that operational capabilities be designed into CNFH's barrier weir so that fisheries managers can facilitate restoration of naturally-produced salmonid populations -- while integrating the mitigation responsibilities of CNFH (USFWS 1998b, CDFG 1998b).

Of the two fish ladders located at the barrier weir, one leads into the hatchery for broodstock collection and the other leads upstream. The Battle Creek Work Group's attention is

focused on the need to improve the upstream ladder to ease any impediments to salmon and steelhead migrating upstream. To provide optimal passage, the attraction flow at a fish ladder needs to provide 10% of the available creek flow 80% of the time. As the existing upstream fish ladder was designed to pass about 40 cfs of water, 10% attraction flow is only available 30% of the time during the time period when spring chinook salmon adult migration is occurring. **Since we want to insure that adult migration of spring run chinook is facilitated, the attraction flow at the upstream ladder needs to be improved.** Objective A in this proposal encompasses the survey, design, and construction of a new fish ladder (or modification of the existing ladder) to meet the professionally recognized standards for fish ladder design (Rainey 1991).

The second objective is to improve the barrier itself. Our recommended solution is a seasonal, drop-in finger weir to more adequately prevent fish from migrating upstream during the critical time period of July through November. Throughout the design process of developing this option, the technical experts will utilize the practice of adaptive management to insure that the "fix" prevents passage, is easily maintained, and minimizes fish injury (Figure 3).

The barrier is currently designed and operated to accomplish three purposes: broodstock collection for the hatchery, restricting access to the upper watershed to prevent hybridization of spring and fall chinook and restricting the upstream area from access by fall and late-fall chinook from the hatchery's water supply to limit disease transmission. The second and third purposes are not being met as undesired fish passage over the barrier weir has been documented. Therefore, the barrier weir is not functioning as a true barrier.

The work described in this proposal has the involvement and support of many agencies and individuals. The list of people who are familiar with and support this proposal includes those involved in the Battle Creek Working Group (BCWG) and the Battle Creek Watershed Conservancy (BCWC). Respectively, these groups represent the agencies/technical advisors on Battle Creek restoration issues and the local watershed workgroup for Battle Creek. Together, these people and agencies will work together to resolve the concerns with this weir that relate to fish population management (CDFG 1993, 1996; Bernard et al. 1996; USFRHAC 1989; USFWS 1995, 1997).

Habitat Restoration Recommended For Funding

Prop. No.	Project Title	Applicant Organization	Recommended Amt.
99-B106	East Delta Habitat Corridor (Georgianna Slough)	Habitat Assessment & Restoration Team, Inc.	\$1,100,000
99-B124	Lake Red Bluff Riparian Area Restoration & Education Support Project	The California Conservation Corps	\$29,114
99-B127	Reintroduction of Endangered Soft Bird's Beak to Restored Habitat - Suisun	University of California at Davis, Dept of Environmental Science & Policy, Wetland Research Lab	\$148,627
99-B130	Development of an Implementation Plan for Lower Yuba River Anadromous Fish Habitat Restoration	Surface Water Resources, Inc	\$171,100
99-B146	Species and Community Profiles of the San Francisco Bay Area Wetlands Ecosystem Goals Project	Friends of the San Francisco Estuary	\$44,000
99-B156	South Napa River Tidal Sough and Floodplain Restoration Project	City of American Canyon	\$1,520,000
99-B161	Riparian Corridor Acquisition and Restoration Assessment	US Bureau of Land Management	\$2,175,000
99-B169	Understanding Tidal Marsh Restoration Processes and Patterns	University of New Orleans, Office of Res. & Sponsored Programs	\$1,042,246
99-B190	Linked Hydrogeomorphic Ecosystem Models to Support Adaptive Mgmt Cosumnes-Mokelumne Paired Basin	University of California, Davis Center for Integrated Watershed Science & Mgmt	\$1,546,016

EXECUTIVE SUMMARY

Project Description

Building upon work already in progress, this tidal marsh and riparian restoration project will substantially improve habitat conditions along more than 14 miles of Georgiana Slough. The specific restoration objectives for this important salmonid migration corridor are as follows:

1. Enhancement of approximately 7 miles of existing berms now vegetated with low quality scrub and/or weedy vegetation, with high quality climax riparian vegetation;
2. Restoration and enhancement of 3 miles of tidal freshwater marsh (tidal perennial aquatic) habitats with plantings on tidal flat berms;
3. Removal of exotic vegetation along the berm and embankment, and the replacement at these sites with native species;
4. Continuation of current and new bioengineering techniques for 3,000 linear feet of new areas, not covered by existing programs, on the Tyler Island side (Reclamation District 563) of Georgiana Slough;
5. Advancement of similar and possibly new bioengineering techniques on 5000 linear feet on the Andrus Island side of Georgiana Slough (Brannan - Andrus Levee Maintenance District, Reclamation District 556); and
6. Expansion of the research monitoring program already initiated on Tyler Island to new sites.

Much work has already been accomplished under an existing CALFED contract for Georgiana Slough, including geomorphic description, hydraulic analysis, vegetation mapping, aerial photography and GIS mapping, bioengineering design, restoration and monitoring plan, and the propagation of tens of thousands of plants native to the Delta. The extension of work already in progress and the addition of new restoration elements affords ideal opportunities for the application of *adaptive management* to this critical resource. The lessons and techniques learned in the earlier phases of the first implemented projects will be modified as necessary to ensure a greater degree of success in the later phases.

Location

Georgiana Slough is a 12 mile long waterway located immediately south of Walnut Grove, California within Sacramento County. The left or east bank is bordered by Tyler Island and is managed by Reclamation District 563; the right or west bank is bordered by Andrus Island and is managed by the Brannan - Andrus Levee Maintenance District, and Reclamation District 556 (Figure 1).

Biological/Ecological Objectives

The implementation of the plan addresses the CALFED primary objective of improving the restoration component of ecosystem function. The efforts of this project will substantially improve tidal marsh and riparian vegetation along this important habitat corridor. While this proposal falls under the category of habitat restoration and the *Focused Action* of East Delta Habitat Corridor (restoration of tidal marsh and riparian habitats along Georgiana Slough, page 20, PSP), its benefits are more far-reaching. Five of the six 1999 PSP funding priorities are

-) addressed: 1) recovery of at-risk native species; 2) the rehabilitation of natural processes in the Bay-Delta system; 3) the protection and restoration of functional habitat types for public values such as recreation, scientific research, and aesthetics; 4) prevention of the establishment and reduction of the negative impact of established non-native species; and 5) improvement of water quality.

Costs

Tables I and II outline the projected budget based on a 3-year program (\$1,234,160) and the first year quarterly estimate and would include all aspects for environmental enhancement for more than 14 miles of Georgiana Slough.

Third Party Impacts

This project will have no known adverse or third party impacts. The local reclamation districts fully embrace both the levee protection component of this project and support the habitat improvements.

Applicant Qualifications

- The Habitat Assessment and Restoration Team, Inc. (HART), is fully prepared to design and implement this project. Located on Steamboat Slough in the Delta, HART's 10-acre facility includes a plant nursery already stocked with native wetland plants, a potting barn and corporate yard, storage and tool sheds, several vehicles, an office with 4 computer workstations (including GIS and graphics capabilities), and considerable room for growth. Jeffrey A. Hart, Ph.D. of HART, Inc. has considerable experience in designing and implementing restoration projects in the Central Valley and the Delta. Well qualified subconsultants providing depth to the Team include: Tyson Holmes, Ph.D. (biologist, statistician); Inter-fluve, The Bioengineering Group, and Robin Sotir and Associates (all bioengineering firms); KSN, Robert Miller And Associates, and DCC Engineering Co., Inc. (all reclamation district engineers); Mitchell Swanson (Hydrologist). Qualified fisheries/invertebrate biologists will be recruited from UC Davis and/or Sacramento State University. Hart will be taking the State Contractors License exam on April 19, 1999.

Local Support/Coordination With Other Programs

This proposal has been submitted with full agreement and understanding from three Reclamation Districts that have jurisdiction for Georgiana Slough: Reclamation District 563 for Tyler Island, and Reclamation Districts 556 for the Brannan - Andrus Levee Maintenance District.

Compatibility With CALFED Objectives

- In addition to the project's compatibility with CALFED biological and ecological objectives (as described earlier), this project is compatible with non-ecosystem CALFED objectives. First, the implementation of this proposal will lessen the chances of levee catastrophic failure by enhancing natural processes of bank protection afforded by natural vegetation. Second, dense habitat plantings will accelerate sediment deposition on bank and near-shore environments, thereby improving water quality.

Executive Summary

The Lake Red Bluff Riparian Area Restoration and Protection Project consists of approximately 200 feet of boardwalk construction over a sensitive old-growth riparian forest area on land managed by the U.S. Forest Service, south and adjacent to the city of Red Bluff, CA. The riparian area in question, 2+ acres, lies on the Sacramento River mainstem. The riparian area will be cleared of invasive exotic plant species (including Tree of Heaven, *ailanthus*) and replanted with native perennial grasses.

The Project forms a discreet part of a larger U.S.F.S. plan for the area, which includes the elimination of several "incidental" trails with one designed, one-half-mile-long, engineered trail, thereby reducing the impact of visitors on the area. The site also serves as part of an outdoor classroom utilized by some 4000 students annually through programs of the Sacramento River Discovery Center, an on site, local non-profit, which strongly supports this project. The USFS estimates annual visitation of 106,000. Congressman Vic Fazio has also toured the area and voiced his support.

The area has been designated as a State of California "Watchable Wildlife Site," and is part of the National "Sacramento River Wildlife Refuge Corridor" established by the U.S. Fish and Wildlife Service.

There are no negative impacts on any third-party. The Project replaces an over-used incidental trail (the result of those 100,000 annual visitors), with an engineered structure. The only impacted population will be those individuals whose mobility is limited, who will find the new trail much more accessible.

The Project will be monitored, and all aspects of the Project evaluated, by the USFS, who has prepared all necessary NEPS documents, and plans to operate and maintain the proposed facility in perpetuity for the benefit of the public.

Over \$37,000 has been allocated for this project, with funding from the USFS and in-kind match from the California Department of Forestry. The additional \$29,114 will bring the project to completion.

The primary ecological objectives are to reduce the destruction of habitat in the area; improve the habitat by eradication of invasive exotic species and the reintroduction of native plants; reduce silt and runoff to the Sacramento mainstem by reducing erosion, thereby reducing damage to spawning areas; and provide an outdoor classroom for use by students in the area.

Letters of support from the USFS and the Sacramento River Discovery Center are attached.

EXECUTIVE SUMMARY

REINTRODUCTION OF ENDANGERED SOFT BIRD'S BEAK TO RESTORED HABITAT IN SUISUN MARSH: RESTORATION STRATEGIES FOR RARE PLANT AND TIDAL MARSH COMMUNITY RECOVERY

UC DAVIS WETLAND RESEARCH LABORATORY

PROJECT OVERVIEW: The goal of this study is to provide critical ecological data to facilitate rare plant restoration, as a contribution towards CALFED objectives for improved ecosystem quality through native species recovery and conservation. We propose an experimental reintroduction of endangered soft bird's beak to its historic range within Suisun Marsh. Previous rare plant translocations based on best professional judgment have resulted in failures and less than ideal outcomes due to lack of critical ecological data (Fiedler 1991, Howald 1996). However, experimental restoration with careful demographic analysis can improve restoration success (Pavlik et al. 1993). The recovery of rare plants often requires the creation of new populations in order to decrease extinction risk. This proposal addresses recovery of a rare plant endemic to Suisun and North Bay high tidal marsh. Understanding habitat requirements critical to this species will provide critical information for other sensitive species including California black rail, Suisun thistle, salt marsh harvest mouse, and Suisun shrew. We will design long term monitoring of the new population and facilitate local involvement in the project.

OBJECTIVES AND SUMMARY:

Objective 1: Investigate Habitat Factors Critical To Soft Bird's Beak.

We will complete a detailed habitat characterization throughout the extant range of soft bird's beak. A wide range of biological and physio-chemical factors will be measured within and outside of the narrow tidal elevation supporting the rare plant. Multivariate ordination techniques will be used to select the most important environmental determinants.

Objective 2: Develop Reintroduction Criteria and Screen Reintroduction Sites.

We will develop reintroduction criteria to locate potential sites and specific microhabitats for new populations, and will screen potential reintroduction sites.

Objective 3: Implement Experimental Rare Plant Reintroduction.

We will experimentally reintroduce soft bird's beak to appropriate habitat within its historic range. The proposed reintroduction site is Spring Branch Marsh at Rush Ranch which was restored to tidal action in 1991. This and other sites will be evaluated by rigorous criteria prior to reintroduction. The endangered plant targeted for recovery is an annual hemiroot parasite which relies on host plants for persistence, and colonizes disturbance microgaps within halophytic vegetation. An experimental framework which tracks the demographic fate of marked individuals in reintroduced and natural populations will evaluate the effects of colonization by direct seeding, seedling transplantation with host plants, and habitat manipulations to suppress canopy and reduce competition such as clipping, substrate variation, and manipulation of natural biological suppression by salt marsh dodder holoparasitism.

The proposed project is being submitted by Surface Water Resources, Inc. (SWRI) on behalf of the Yuba River Fisheries Technical Working Group (YRFTWG). The project involves the development of a local-level, multi-agency, consensus-based implementation plan (Implementation Plan) to direct the near-term implementation of prioritized Yuba River anadromous fish habitat enhancement/restoration actions and studies. No such plan has been developed to date for the Yuba River. Completion of this proposed project will assist CALFED with numerous ERP goals, objectives, and actions. In particular, it will facilitate achieving CALFED's Strategic Plan objective of working with stakeholders in local watersheds and communities to develop local implementation plans that will effectively facilitate restoring processes and habitats that benefit priority fish species, including chinook salmon and steelhead. Although submitted under the topic area of Habitat Restoration: Channels, Floodplains, and Marshes, this project has linkages to CALFED topic areas of Watershed Stewardship and Improved Fish Management/Hatchery Operations.

The project's primary ecological/biological objectives include:

- ▶ developing a detailed implementation plan providing the conceptual framework and process that will guide the refinement, evaluation, prioritization, implementation, monitoring, and post-monitoring revision of ERP actions, as well as actions proposed by other agencies, and newly developed actions;
- ▶ facilitating implementation of prioritized Yuba River enhancement/restoration actions and studies leading to the recovery of the lower river's fall-run/late-fall-run and spring-run chinook salmon, steelhead, and other anadromous fish populations; and
- ▶ structuring the implementation of near-term actions and studies in a manner that promotes effective recovery of chinook salmon and steelhead populations, while increasing knowledge pertaining to how key watershed and river structures, processes, operations, and related factors work individually and collectively to influence anadromous fish habitat and populations within the lower river.

Implementation of actions and studies refined and prioritized under this project will protect, enhance, and restore Yuba River aquatic and riparian habitats, the key processes that create and maintain these habitats, and the anadromous fish species that use such habitats (particularly chinook salmon and steelhead), while increasing our understanding of ecosystem structure and function. This project also will benefit other anadromous species, including green and white sturgeon, American shad, striped bass, and Pacific lamprey, as well as native resident fish species. Priority habitats to be benefited include essential and freshwater fish habitats, riparian habitats, and main-channel and side-channel riverine aquatic habitats. Development of a successful model for local involvement of diverse interests, use of a technical working group to refine, evaluate, and prioritize actions for near-term implementation while maintaining a long-term watershed perspective, arranging cost-sharing agreements to facilitate adequate funding, and effective monitoring and adaptive management for the Yuba River, will benefit restoration and planning efforts being undertaken in other areas, thereby facilitating more rapid and effective ecosystem restoration and watershed planning elsewhere in the Bay-Delta system.

The proposed project will not conduct field monitoring and data collection, but rather will guide monitoring and data collection for prioritized actions and studies upon their implementation. An "Ecological/Biological Monitoring and Methods Plan" will constitute a section of the Implementation Plan. The field-monitoring component of this section will identify monitoring objectives, hypotheses to be addressed (defined in the conceptual model, also included in the Implementation Plan), and indicators (i.e., parameters) to be monitored. The Implementation Plan will provide significant additional guidance pertaining to evaluation of action and study success (e.g., use of performance standards), evaluating and interpreting monitoring findings, and reporting mechanisms (e.g., frequency, content, format, and recipients). Hence, the monitoring and methods section of the Implementation Plan will provide guidance

with regard to the use of monitoring data to address: 1) objectives, questions, and hypotheses associated with each action/study; and 2) action/study success; and 3) improvements in ecosystem health and function, as actions are implemented. Action- and study-specific experimental designs, specific sampling and data-collection techniques, and specific techniques to manage, analyze, and evaluate monitoring data will be developed (under separate projects) by the parties that will be implementing actions and conducting studies prioritized by this project.

The proposed project would provide third-party benefits to agencies/organizations involved in management and restoration of fishery resources in other watersheds, anglers, and others recreating along the Yuba River. A secondary benefit of the project is that the conceptual model and prioritized actions developed as part of the Implementation Plan will provide key information for the development of a watershed management plan. Work conducted under this project would both complement and benefit from work currently being performed in the upper Yuba River watershed by the Yuba Watershed Council, a 26-member stakeholder group who's mandate is to improve watershed stewardship. Benefits to other ecosystem restoration programs include the USFWS's Anadromous Fish Restoration Program (AFRP) and CDFG's fishery management plans for the Yuba River. No adverse third-party impacts have been identified for this project.

The project will be completed over a two-year period. The total cost of the project is **\$221,100**. At a meeting held on April 13, 1999, the Yuba County Water Agency's Board of Directors approved the project proponent's request for a **\$50,000** local cost-share in support of this project. In-kind services will be provided by staff from each of the YRFTWG participating agencies/organizations to attend bi-monthly planning meetings and four public meetings, coordinate work activities, and develop and/or review task-specific work products. Consequently, the total amount of funding requested from CALFED is **\$171,100**.

The core technical team for the project will be comprised of the YRFTWG participants, including: *Gary Taylor*- Branch Chief, Energy and Instream Flow, *Michael Morse*-Senior Fish and Wildlife Biologist, Energy and Instream Flow, *Carl Mesick*-Habitat Restoration Coordinator, and *Craig Fleming*-Fisheries Biologist of the U.S. Fish and Wildlife Service; *John Nelson*-Environmental Specialist IV, Sacramento Valley-Central Sierra Region and *Bill Snider*-Stream Evaluation Program Leader of the California Department of Fish and Game; *Karl Halupka*-Fisheries Biologist for the National Marine Fisheries Service; *William Mitchell*-Fisheries Biologist, Jones and Stokes Associates, on behalf of YCWA; Dr. Michael Bryan, Senior Fishery Biologist/Water Quality Specialist, SWRI; *Craig Seltenrich*-Aquatic/Fisheries Biologist for Pacific Gas & Electric Company; *Shawn Garvey*-Executive Director of the South Yuba River Citizens League; and *Jen Carville*-Hydro-policy Advocate for Friends of the River.

The YRFTWG Team will be led by Dr. Michael Bryan of Surface Water Resources, Inc. (SWRI). Dr. Bryan has 13 years of combined research and consulting experience addressing how physical, chemical, and biological characteristics of aquatic habitats affect fish and other aquatic biota. He was appointed to the Lower Sacramento River and Delta Tributaries Technical Team, as part of the Anadromous Fish Restoration Program of the Central Valley Project Improvement Act. As part of this team, Dr. Bryan developed technical reports outlining the key factors that are currently limiting chinook salmon and steelhead populations in the lower Yuba and American rivers. Mr. Paul Bratovich, also of SWRI, will provide additional technical fisheries expertise. His 16 years of local experience includes regulatory and technical consultations with the California Department of Fish and Game, the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and other agencies concerning flow-habitat relationships, habitat restoration, population dynamics, endangered species, and strategic water planning.

Executive Summary

The San Francisco Bay Area Wetlands Ecosystem Goals Project is a multi-agency, interdisciplinary planning effort whose main objective has been to identify the kinds, amounts, and distribution of wetlands and related habitats needed to sustain diverse and healthy communities of fish and wildlife resources in the San Francisco Bay area. The Project presented its final recommendations in March 1999 in its report entitled *Baylands Ecosystem Habitat Goals*. The report provides guidance for private, local, state, and federal entities seeking to protect and improve the region's wetlands. It also forms the biological basis for a regional wetlands plan, the development of which is scheduled to begin in mid-1999.

In collaboration with members of the Goals Project's Resource Managers Group, the Friends of the San Francisco Estuary (Friends) is seeking CALFED funding to produce the Goals Project's final product - a report of species and communities profiles. The text of this report is nearly complete, and Friends is requesting CALFED funds for the preparation of the report's final design and maps, and for printing and distribution. The report will be approximately 600 pages in length and will include profiles for 97 species of insects, fishes, amphibians, reptiles, mammals, and birds that occur in the Bay-Delta estuary. It also will include profiles for four plant communities: intertidal bayland, tidal marsh, diked bayland, and salt pond. The Profiles report will be useful for scientists, educators, consultants, and others who are working to restore or improve habitats in the Bay-Delta estuary.

The Goals Project has received funding from a variety of local, state, and federal entities. Direct funding to date totals about \$725,000. In addition, more than one hundred technical experts from the private and public sectors have contributed in-kind services valued at about \$950,000.

Friends and the Resource Managers Group seek \$44,000 from CALFED to produce the Goals Project's Species and Community Profiles report.

We believe there will be no direct third party impacts resulting from the preparation of the species and communities profiles report.

Friends is a non-profit corporation with representatives from educational, environmental, business, government, and the private sector. It was established by the San Francisco Estuary Project in 1991 to build support for the Estuary Project's programs and goals, to provide environmental education activities to the public, and to assist with implementing the Estuary Project's Comprehensive Conservation and Management Plan. Staff of Friends has provided assistance to the Goals Project since 1995.

Mr. Michael Monroe and Ms. Peggy Olofson will oversee production of the *Species and Community Profiles* report. Mr. Monroe is an environmental scientist with the U.S. Environmental Protection Agency and is co-chair of the Goals Project. Ms. Olofson is an environmental engineer with the S.F. Bay Regional Water Quality Control Board and is the Goals Project manager. They were the primary authors of the *Baylands Ecosystem Habitat Goals* report. To produce the Profiles report, they will utilize the services of Ms.

CALFED Proposal
April 16, 1999

2.

Friends of the Estuary
Species and Community Profiles

Nina Lisowski for report design, the San Francisco Estuary Institute for GIS map production, and Alonzo Environmental for report printing.

During the development of the Habitat Goals, Goals Project participants indicated strong support to produce a compilation of the species and community profiles that they had prepared as a preliminary step towards developing the Goals. The Resource Managers Group views these profiles as important supporting documentation for the final Goals Report and wants to make them available as a companion document. The Profiles report will assist CALFED in deciding appropriate wetlands projects to fund. In particular, it will provide CALFED a stronger scientific basis for decisions regarding the restoration of certain kinds of wetlands as described in the CALFED Environmental Restoration Program Plan.

99B-156
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III. EXECUTIVE SUMMARY

A. PROJECT DESCRIPTION AND PRIMARY BIOLOGICAL/ECOLOGICAL OBJECTIVES

The City of American Canyon is in the process of acquiring 453 acres of wetlands adjacent to North Slough and the Napa River, from the Port of Oakland, using 1998 CALFED funding. The proposed project will restore this important area to tidal marsh. In addition, the City will donate an additional 58 acres of adjacent wetlands and upland to this restoration effort, and create a visitors' viewing area and interpretive program on the east side of the Napa River near its mouth with San Francisco Bay. Not less than 70% of the project lands would be granted in fee title to the CDFG to manage as a wildlife area. The City would retain fee-title ownership of up to 30% of the project lands, and manage those lands in a manner compatible with CALFED objectives.

The project site is unique in that it defines the historic edge of the Bay, and has a largely intact system of tidal sloughs, which are largely cut-off from tidal action by a levee at the confluence of North Slough and the Napa River. During the 1997 floods, a small breach in one levee was formed, thereby allowing partial tidal influence. This breach has not yet been repaired. The project will allow the restoration of tidal marsh - contiguous with adjacent natural upland transition areas - creating a unique habitat for several CALFED priority species. Restoration of tidal wetlands would be achieved by removal of approximately 30 acres of City-owned sewage ponds, breaching existing levees along the Napa River, restricting cattle grazing, and creating wetlands in upland areas. This project would contribute to the restoration of priority habitats, including tidal perennial aquatic habitat, saline emergent wetland habitat, tidal sloughs, seasonal wetlands, and perennial grasslands. The restoration of these habitats would provide ecological benefits for many target species, including delta smelt, splittail, Chinook salmon, California clapper rail, California black rail, salt marsh harvest mouse, shorebirds, wading birds and waterfowl, and others.

B. APPROACH/TASKS/SCHEDULE

Project coordination and management will be accomplished by a committee consisting of City and agency personnel. Consultants would complete necessary environmental documentation and permitting, conduct preliminary project design work, and begin restoration work by breaching levees and removing sewage ponds. The complete project could be completed in two years.

C. JUSTIFICATION FOR PROJECT AND FUNDING BY CALFED

Funding from CALFED in the previous round made the acquisition of the Port of Oakland property possible. Without additional funding from CALFED, it is unlikely that the proposed restoration project will occur. Continued use of the American Canyon sewage treatment ponds would preclude restoring the area to full tidal action, since tidal action would endanger the pond levees and increase the risk of a sewage release. With CALFED funding, a unique habitat would be protected and improved, Ecosystem Restoration Program Plan (ERPP) objectives would be supported, habitat for sensitive priority species would be restored and conserved. The project will likely address CALFED's Water Quality and Levee System Integrity objectives as well.

D. BUDGET COSTS AND THIRD-PARTY IMPACTS

Budget costs for CALFED funding are itemized below by task. No third-party impacts are anticipated to result from the proposed project; however, the breaching and/or removal of levees will be conducted in consultation with flood control agencies, in particular the U.S. Army Corps of Engineers, and adjacent property owners, to ensure that there are no adverse flooding impacts.

Phase 1 Tasks – Previously Funded by CALFED in 1998		Cost per Task
1.1	Acquisition of Port of Oakland property fee title and easement transfers: Appraisal underway; acquisition projected to close on July 1, 1999	\$1,400,000
1.2	Preliminary design for levee breaches, pond removal and restoration of City property, Port of Oakland property restoration and wetland creation, and creation of viewing area and new levees: Underway	\$40,000
1.3	Environmental constraints study: Underway	\$15,000
Phase I Total		\$1,455,000
Phase 2 Tasks – Requested Additional CALFED Funding		
2.1	CEQA / NEPA documentation	\$250,000
2.2	Permitting	\$40,000
2.3	Final design plans and specifications for earthwork/demolition/restoration work	\$100,000
2.4	Breach levees, restore tidal action	\$330,000
2.5	Remove wastewater pond levees	\$380,000
2.6	Restoration of Port of Oakland upland	\$150,000
2.7	Construct viewing/educational area facilities	\$60,000
2.8	Construct new levees to protect City facilities	\$120,000
2.9	Environmental monitoring (short and long term)	\$90,000
Phase 2 Total		\$1,520,000
Total 1999 Request from CALFED		\$1,520,000

E. APPLICANT QUALIFICATIONS

A highly qualified team, led by John Wankum, the City of American Canyon Public Works Director, has been assembled to carry out the proposed project. An organizational chart detailing team members is attached as Figure 3. The team, consisting of City staff and technical experts from Environmental Science Associates and HydroScience Engineers, has successfully completed projects of similar magnitude and complexity throughout California.

F. MONITORING AND DATA COLLECTION

The City will oversee monitoring efforts once the project has been completed with the work being done by City personnel, consultants, or the CDFG. Data will feed into an adaptive management plan that will guide the on-going management of the tidal marsh. A monitoring program will be in place for the life of the project with initial support from CALFED funds, and long-term support from CDFG resources.

G. LOCAL SUPPORT/COORDINATION WITH OTHER PROGRAMS

The proposed project enjoys support from the City of American Canyon, CDFG, the Napa County Land Trust, the San Francisco Bay Joint Venture, the Port of Oakland, the Natural Resource Conservation District, and the U.S. Army Corps of Engineers. This restoration effort will be closely coordinated with the continued restoration and management of CDFG's Napa Sonoma Marsh complex located immediately to the south of the project site.

I. Executive Summary

Our interdisciplinary team of researchers proposes to build on and expand initial CALFED Category III- supported research in the Sacramento-San Joaquin Delta (Delta)¹ to address considerable uncertainty in predicting the outcome and ecological benefit of restoring shallow-water tidal habitat in three different regions of the Bay-Delta: the Delta, Suisun Bay, and San Pablo/North Bay. This team is composed of sedimentologists, hydrologists, geomorphologists, fisheries and avian biologists, and estuarine ecologists from the University of Washington, School of Fisheries' Wetland Ecosystem Team (UW-WET), University of New Orleans (UNO), Philip Williams & Associates (PWA), San Francisco State University-Romberg Tiburon Environmental Center (SFSU-RTC), Pt. Reyes Bird Observatory (PRBO) and the California Department of Water Resources-Interagency Ecological Program (DWR-IEP). Our intent in this proposed study is to extend and refine the emerging results of the BREACH approach to the other regions under consideration in the CALFED Ecosystem Restoration Plan (ERP).

In the present BREACH project, we are studying historically-restored and remnant natural wetland sites in the Delta to determine how far (if at all) they are along important 'functional equivalency trajectories' (Simenstad and Thom 1996) that will indicate progress toward the CALFED goal to "*rehabilitate the capacity of the Bay-Delta system to support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities, in ways that favor native members of those communities*" (ERP Goal 2). Initial findings from these Delta studies suggest that restoration of emergent tidal-freshwater and brackish wetlands of the Delta is contingent upon the interaction of tidal and fluvial processes with vegetation communities that depend upon prior (e.g., subsidence) and initial (e.g., breach locations) conditions affecting the rate of emergent marsh colonization and expansion. Accordingly, biological communities that are associated with various habitat (e.g., water depth) and vegetative structure will dominate restoration sites through the duration of various successional stages. However, many factors influencing the rate and pattern of shallow water habitat restoration are significantly different between the Delta and other regions under consideration for restoration actions by CALFED. Differences in tidal regime, fluvial influence, suspended sediment sources, vegetation communities, ex species and anthropogenic manipulations may result in significant divergences from our present understanding of restoration stages and endpoints originating from studies in the Delta. By identifying the corresponding biological communities and food webs associated with transitional restoration stages in the three regions of the Bay-Delta, we propose to use a refined and extended BREACH conceptual model to address emerging questions about shallow water restoration, such as:

1. *What is the timeframe of restoration to a natural shallow water habitat? What are the limiting factors?*
2. *What is the interaction between submerged aquatic vegetation (SAV) and emergent shallow water vegetation? Does SAV promote or inhibit the transition to an emergent marsh?*
3. *Do native species benefit from interim transitional stages in recovering breached-levee sites? Are nonindigenous fishes or concentrations of piscivorous birds detrimental to native fishes utilizing the site?*
4. *Do shallow water ecosystems contribute significantly, either as organic matter sources or intermediate pathways, to Bay-Delta food webs important to important species?*
5. *What are the ecological attributes of successful restoration?*

Thus, this proposal addresses both the feasibility of restoration of shallow water habitat, and differences inherent to different regions of the Bay-Delta continuum, as well as evaluates the contribution of that endpoint to the long-term recovery of fisheries and ecological integrity of the Bay-Delta. Our goals of the proposed refinement and expansion of the BREACH investigations are to: (1) systematically address the present status, rates, and patterns of tidal ecosystem restoration in recognizably different Bay-Delta ecosystems; (2) evaluate factors that promote rapid restoration of shallow-water habitat *versus* factors that have potentially inhibited natural rates and patterns of functional development; (3) evaluate the contribution of shallow water habitats to food webs supporting Bay-Delta ecosystems; and (4) assess the overall outcome of breached-levee restoration

¹ See <http://weber.u.washington.edu/~calfed/calfed.htm>

in the different Bay-Delta regions and recommend optimum strategies and spatial distribution of future restoration initiatives. The focus of our sampling design and synthesis is a BREACH conceptual model that we have developed for restoration patterns, rates and processes in the Delta.

We expand from the Delta to Suisun Bay-San Pablo/North Bay our BREACH approach of using the "natural experiment" of the diverse age distribution of selected breached-levee sites in a 'space-for-time substitution' to predict the patterns and rates (trajectories) of restoration that would be expected from levee breaching. In our initial CALFED studies in the Delta, we are systematically evaluating the rates and patterns of restoration, and determining sources of variability, in both naturally and artificially restored diked wetland sites of a broad spectrum of ages as compared to the reference sites. The overall objectives of the BREACH project are to: (1) Assess hydrological, geomorphological, biogeochemical and ecological indicators at diverse, differently-aged sites of formerly diked wetlands that have reverted to tidal inundation; (2) compare indices of fish and wildlife habitat quality of these naturally breached-dike sites to existing mitigation and restoration sites that were purposefully constructed by dike breaching or comparable restoration actions; and, (3) using the same indicators, compare the status of these restored wetlands to wetland function at natural reference marsh sites. This approach is integrated into a developing conceptual model (see Appendix A) that relates transitional phases in the development of shallow water habitat to the support of fish and wildlife.

In our expansion of the BREACH investigations, we will:

- Refine and extend applicability of BREACH conceptual model by (a) elucidating rates of transition between vegetated and non-vegetated habitats, and rates of transition from one floral community to another, and (b) adapting it for processes, conditions and floral/faunal communities in more saline regions of Bay-Delta.
- Prepare synthesis of patterns, rates and short-term and long-term endpoints of tidal marsh restoration predicted from refined conceptual model for breached-levee restoration along the Bay-Delta continuum.
- Assess food web contributions of restoring marshes to consumer organisms, in conjunction with collaborating existing/proposed CALFED studies.
- Disseminate intermediate and final results to the CALFED and regional wetland restoration community by organizing and/or participating in sessions in relevant conferences and/or organizing specific opportunities for interaction and discussion.

We will address these objectives in five tasks and associated subtasks distributed in three phases over 3.3 years:

- (1) Refine conceptual model development for Delta (Phase I); a. conduct two BREACH workshops to design, modify and incorporate new data and other information into expanded conceptual model; present to IEP Project Work Team and other related scientific bodies for feedback; b. investigate subtidal accumulation processes; c. investigate marsh expansion processes, including interactions between tule and submerged aquatic vegetation; d. continue measurements of elevation change to refine rate estimates for Delta systems; e. as opportunity arises, incorporate additional/existing data to test model;
- (2) Extend conceptual model development to Suisun Bay and San Pablo/North Bay (Phase I); a. inventory of "restoring" marsh and natural marsh reference sites; b. review of existing studies in Suisun March and San Pablo/North Bay marshes; c. select ~12 sites, including 7-8 restoring, 2-3 reference, 1-2 managed/seasonal/salt pond wetlands; d. conduct geomorphic assessment at all sites;
- (3) Assess relationship of fish, macroinvertebrates, and avifauna to restoration status (Phase II); a. document seasonal fish community composition, life history and relative abundance; b. document seasonal macroinvertebrate community composition, life history and relative abundance; c. document seasonal avifauna composition, abundance and behavior;
- (4) Evaluate food web and other ecosystem linkages (Phase III); a. conduct stable isotope analyses of representative consumer organisms; and, b. compare to conventional fish diet results.
- (5) Prepare synthesis document and presentations (Phase III).

Products are intended to provide critical information necessary to predict whether breached-dike restoration strategies proposed under CALFED would provide natural wetland functions to support tidal (shallow-water) aquatic habitat for other aquatic and terrestrial species of concern and rehabilitate a robust Bay-Delta food web.

99 B-161
Panel D

EXECUTIVE SUMMARY

The U.S. Bureau of Land Management (BLM), in a joint-venture partnership with the California Department of Water Resources (DWR) and the Trust for Public Land (TPL), is requesting \$2,175,000 in Category III CALFED funds to ensure future restoration opportunities along the Upper Sacramento River. This project will protect critical habitat through conservation easements and fee title acquisitions, and provide a foundation for ecosystem restoration specific to the project area. Approximately 1,920 acres, five miles of Sacramento River frontage, four and one-half miles of Battle Creek frontage, and one mile of Anderson Creek frontage will be preserved.

The project is located in Shasta and Tehama Counties along the Sacramento River between Jellys Ferry bridge and the mouth of Cow Creek (RM 267-280) (See Attachment A). The majority of the project falls within the BLM's Sacramento River - Bend Area of Critical Environmental Concern (ACEC), and the entire project area is within the geographic scope of the 1999 CALFED proposal solicitation package.

This project involves two components: 1) protection of approximately five miles of Sacramento River frontage, four and one-half miles of Battle Creek frontage, and one mile of Anderson Creek frontage through acquisition of fee title and conservation easements, and 2) preparation of a Habitat Restoration Assessment of the Sacramento River between Jellys Ferry bridge and the mouth of Cow Creek between river miles (RM) 267-280.

TPL is currently negotiating the protection of two properties — Greening and Gover Ranches — through a combination of fee title acquisitions and conservation easements. As outlined in this proposal, these properties will be acquired and managed by the BLM.

The Greening Ranch includes roughly 245 acres of Rancherie Island, alternately known as Reading Island or Goat Island, and is located at the mouth of Anderson Creek. Approximately 173 acres of undeveloped, mature valley oak grassland will be acquired in fee and the balance of the property will remain in walnut production, protected from future development through an agricultural easement.

The Gover Ranch includes roughly 1,675 acres. A conservation easement buffer along the Sacramento River and Battle Creek is proposed for the Bloody Island portion of the ranch. The interior of Bloody Island will remain in orchard production and will be protected by an agricultural easement. Approximately 100 acres east of Gover Road and adjacent to the Battle Creek State Wildlife Area will be managed in coordination with the Department of Fish and Game (DFG).

Purchase of conservation easements on Bloody Island between RM 271-274 will also protect and allow existing pockets of riparian forest along the river bench to reach maturity, and will provide outstanding opportunities to conduct reforestation activities both along the river bench and within the alluvial tip of Bloody Island, as well as along the historic confluence with Battle Creek roughly two miles north of the present day confluence.

A Habitat Restoration Assessment will be conducted by DWR as part of this project, in

coordination with DFG and The Nature Conservancy (TNC). The Assessment will examine geomorphic and riparian interactions occurring on the Sacramento River between the mouth of Cow Creek and Jellys Ferry bridge to determine restoration possibilities for the integrated complex that includes lands owned and managed by BLM, the acquisitions identified in this proposal, and other potential acquisitions of fee and/or conservation easements from willing sellers within this reach.

This project will create an excellent opportunity to restore physical and successional processes through the potential reestablishment of a natural hydrologic regime within this historic meander area. Ongoing habitat restoration efforts by local conservation organizations, land conservancies, and public agencies will be complemented by this project. Additionally, this project is consistent with CALFED's Ecosystem Restoration Program as it will improve the health of vital ecosystem functions within the Bay-Delta system.

The boards of supervisors and planning departments for Shasta and Tehama Counties have been notified of the project (notification letters attached). Individual members of each board of supervisors have been briefed, and representatives from both boards have reviewed the project proposal through the Sacramento River Advisory Council. The Advisory Council has determined that the project is consistent with and furthers the objectives of the Sacramento River Conservation Area (Attachment B).

Redding BLM staff collectively possess more than 300 years of natural resource management experience. The office has long-term management experience with properties near and/or similar to the Greening and Gover properties. DWR staff have conducted numerous studies including "Upper Sacramento River Spawning Gravel Study," and "Sacramento Valley Westside Tributary Watersheds Erosion Study." Current ongoing studies include "Woodson Bridge Bank Erosion Study," "Sacramento River Bank Erosion Study," and "Battle Creek (PG&E) Coleman Diversion Dam Restoration Foundation Investigation." Environmental and fisheries aspects will be handled by the Northern District Environmental Studies Section and the DFG. TPL is a national, nonprofit conservation organization with over 26 years of experience in acquiring critical land and water resources from willing sellers for restoration and preservation. To date, TPL has acquired and conveyed into protective public or nonprofit stewardship over 1 million acres in the United States valued at over \$1.4 billion. TPL's core competencies are in business, finance, law, and real estate.

II. Executive Summary

99B-190
panel A

The University of California, Davis Center for Integrated Watershed Science and Management (CIWSM), in partnership and collaboration with foundation, agency and university partners, propose to develop a demonstration monitoring and assessment program for the CALFED Cosumnes and Mokelumne River Ecological Management Units. The *Cosumnes Consortitum* will focus upon on-going and planned restoration efforts within the Cosumnes and Mokelumne Watersheds with the intent of providing technical and informational support for restoration planning and design, developing new analytical tools and information systems that support implementation of CALFED's ERP, Watershed Management, Water Quality and Levee Integrity Programs, and providing baseline studies and targeted research for long-term biologic and hydrogeomorphic monitoring in support of CMARP.

This project takes advantage of the unique hydrologic, ecologic and institutional opportunities that exist within the Cosumnes and Mokelumne watersheds. The Cosumnes watershed, with its relatively intact hydrologic system and extensive restoration programs, affords the opportunity to conduct and evaluate a broad spectrum of restoration experiments that support multiple objectives of CALFED programs. The closely adjacent Mokelumne River, with its highly altered and regulated hydrogeomorphic system, makes it possible to develop and test new restoration methods and to evaluate their effectiveness in direct comparison with a similar, more naturalized system.

This proposal seeks funding of \$1,946,016 for three years to support six core programs. All programs are intended to be collaborative, with direct involvement and contribution from agencies currently conducting restoration, monitoring and research within the basins. For this reason, budget estimates are considered tentative.

The Consortium project has been subdivided into six core programs that support development of predictive models for hydrogeomorphic and ecosystem function in support of a broad range of CALFED ecological/biological objectives. These include:

HYDROLOGY: In order to optimize integration within the Consortium, all empirical, conceptual and predictive models will be tied to a linked surface water/groundwater model in development at UC Davis. The UC Davis Hydrologic Model is physically-based and spatially-distributed, allowing its use over a wide range of watersheds and scales. This model will be used to simulate the impact of historic and projected land use/land cover changes and water management methods on the Bay-Delta. Cost: \$225,027.

GEOMORPHOLOGY: A range of non-traditional flood management measures are currently being considered in the Cosumnes and Mokelumne basins. The primary focus of the geomorphology program is the documentation and simulation of hydrogeomorphic impacts of levee setback and breach designs that optimize both restoration and flood management goals. This request includes partial funding for the development of a dynamic meander migration model, coupled to the hydrologic model. It is anticipated that this work will directly address design of flood management programs throughout the CALFED region. Additional work in the Geomorphology program includes paired basin study of the impact of land use on sediment flux. Cost: \$192,576.

WATER QUALITY: The CIWSM will develop a paired basin water quality and aquatic food resource monitoring and modeling program. The objective of this program is to document

the links between upland watershed processes, water management, and the health and lower trophic level productivity of lowland and Bay-Delta ecosystems. Results from this program will contribute to high priority issues, such as drinking water quality, fluxes of organic materials contributing to halogenation reactions, and development of total maximum daily load (TMDL) criteria for upland watersheds. The paired basin approach affords the unique opportunity to directly assess the relative effects of water retention structures on water quality and food resources in the Delta. Cost: \$300,000.

AQUATIC RESOURCES: the aquatic resources program will focus on a comparison of the successional, naturalized aquatic ecosystems of the Cosumnes Basin with the highly regulated ecosystems of the Mokelumne River. The collaborative sampling program will emphasize three issues: the relations between hydrogeomorphic processes and function of naturalized aquatic ecosystems, adaptive management of successional trajectories in order to enhance native species and reduce nonindigenous species (such as the Chinese Mitten Crab), and assessment of the benefits of restoration efforts within and outside of the basins. Cost: \$407,049

TERRESTRIAL RESOURCES: In order to guide design and implementation of changes in floodplain management, a spatially explicit vegetation patch dynamic model will be developed that allows simulation of riparian response to levee and channel modification, both within the naturalized reaches of the Cosumnes and the close-leveed, dam-regulated reaches of the Mokelumne. This riparian patch dynamic model work will be supported by the development of a GIS-based model of riparian bird habitat. The aim will be to identify landscape features that serve as predictors for high-quality riparian habitat and can be mapped easily at the scale of several watershed. Cost: 396,498.

DATA ANALYSIS and DISSEMINATION: The UC Davis Information Center for the Environment (ICE) will manage and support the GIS for all core programs in the Consortium. This program will include maintenance of GIS data bases, development of new data layers, GIS support for investigators, and exchange with decisionmakers and stakeholders. The cost of this program during this project is \$318,197. In conjunction with this process, ICE will develop new mapping and analysis tools to support watershed restoration programs in watersheds throughout the CALFED region. These web-based tools will be prototyped in the Cosumnes and Mokelumne basins. Cost: \$106,669.

All six core programs will be directed by UC Davis faculty. Each faculty member is a recognized expert in their field of specialization and have well-established research programs. The CIWSM will coordinate all activities of the project, including preparation of reports for CALFED and presentation of public symposia and workshops. With Packard Foundation Conservation Program support, the CIWSM is able to provide \$250,000 in matching funds for this project. In addition, UC Davis will supply in-kind services including space, faculty salaries, and computing system support.

The foundation of this project is the recognition that baseline studies that will be used to test and validate predictive models will also guide the design and implementation of a long-term monitoring program dedicated to CALFED's adaptive management goals. This will involve extensive coordination between core programs, including choice of georeferenced, replicate monitoring sites that meet multiple monitoring and assessment objectives. This monitoring program will be developed in cooperation with CALFED program personnel and be subjected to rigorous peer review.

Local Watershed Stewardship Recommended For Funding

Prop. No.	Project Title	Applicant Organization	Recommended Amt.
99-B131	YUBA TOOLS: Collaborative Watershed Mgmt for Flood Control	Yuba Watershed Council & SYRCL	\$216,150
99-C118	Biological Ag Systems in Cotton-BASIC- Reducing Synthetic Pesticides & Fertilizers in the No. SJ Vly	Sustainable Cotton Project (SCP)	\$460,000
99-C121	Douglas/Long Canyon Paired - Watershed Project	Placer County Water Agency - PCWA	\$83,600

II. EXECUTIVE SUMMARY

YUBA TOOLS

A TOOLBOX INVESTIGATION OF WATERSHED MANAGEMENT TECHNIQUES AVAILABLE FOR ENHANCING FLOOD PROTECTION IN THE YUBA WATERSHED [YUBA TOOLS PROJECT]

Watershed
Panel A

PROJECT DESCRIPTION/ECOLOGICAL OBJECTIVES

Residents living in the floodplain of the lower Yuba River watershed are threatened annually with high water events. Over time, these events have caused substantial devastation and loss of life and property. This project proposes an investigation of various non-dam watershed management techniques to enhance flood protection while maintaining or improving natural processes, habitat and populations of high priority at-risk species, including chinook salmon and steelhead.

The project team proposes establishing an 18-month-long stakeholder-based collaborative process to identify and evaluate flood control alternatives for the Yuba River watershed, with the goal of developing a suite of effective structural and non-structural measures that balance ecological and human demands on Yuba River resources. A steering committee of representatives from existing watershed coalition groups and other interested stakeholders will be established as part of the project. This steering committee will work with a project coordinator and technical team to evaluate various flood control measures, their flood control and ecosystem benefits, and any potential impacts on river processes, habitat or species. This analysis will form the basis for recommendations for implementation.

With more meaningful stakeholder involvement, this collaborative study will provide educational opportunities as well as experimental tools to increase the public's understanding of floodplain management and restoration actions. In addition, the project augments the habitat restoration and water quality improvement work being undertaken by watershed coalition groups established through existing CalFed- and Proposition 204-funded projects in the upper and lower Yuba watershed.

The most effective management of the flood plains of the major rivers may not be a primarily "structural approach" of building levees and dams, but rather a combination of structural and nonstructural approaches that considers the many interrelated benefits to society offered by river systems.

-- Army Corps of Engineers
excerpted from *Sacramento and San Joaquin River Basins Comprehensive Study*
Newsletter, Issue 1

COMPATIBILITY WITH CALFED OBJECTIVES AND FUNDING GOALS

The Yuba River watershed drains approximately 1,300 square miles of the western Sierra Nevada slope and includes portions of Sierra, Placer, Yuba and Nevada counties. Because the Yuba supports highly valued populations of steelhead trout and spring- and fall-run chinook salmon, as well as other anadromous and resident fish communities, it is considered "one of the most important Ecological Management Units in the Feather River/Sutter Basin Ecological Management Zone," according to CalFed's 2/99 Revised Draft of the *Ecosystem Restoration Program Plan*, Vol. II (p. 281).

To protect and enhance habitat for these target species, the YUBA TOOLS project focuses on evaluating ecologically sustainable, non-dam flood control alternatives. The project team will work collaboratively with existing watershed-based coalitions, established through previously funded CalFed and Proposition 204 projects, whose memberships include representatives from agencies and organizations with specific interests in the Yuba watershed (see Section VII and Appendices for full list of collaborators).

The project will investigate watershed management and flood control techniques that help achieve overall CalFed objectives, including:

- 1.) improving and increasing aquatic and terrestrial habitats and ecological functions to support sustainable populations of diverse and valuable plant and animal species;
- 2.) providing good water quality for all beneficial uses; and
- 3.) reducing the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic failure of levees.



YUBA TOOLS

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Specific ERPP goals will be addressed, as well, including: improving stream-channel and riparian habitat, maintaining gravel recruitment and sediment transport processes, and preserving river meander zones and active floodplains.

These techniques [see box] have been shown to be effective elsewhere; but they need to be studied specifically in relation to what combination might best serve the Yuba watershed. Such a study will help improve our understanding of hydrologic, geomorphic and ecological relationships and assist in the evaluation of ecologically based alternative water management strategies, as called for under the Habitat Restoration Topic Area and General Bay-Delta Focused Actions identified by the CalFed Integration Panel (2/99 PSP, p. 18-19).

ADVERSE AND THIRD PARTY IMPACTS

In its own flood control study process, Yuba County Water Agency rejected most non-dam flood control options in favor of more structural approaches. Each of YCWA's 12 preliminary alternatives includes at least one major new dam or reservoir in the Yuba watershed – and in some cases, two or three. These projects conflict with CalFed's vision for more natural ecological processes; improved riparian, wetland and riverine habitat; reduction of stressors, such as dams, in the watershed; and increased populations of target species like salmon and steelhead. The process used to develop these alternatives was neither collaborative nor consensus-based and failed even to consider ecological criteria in the initial assessment.

Residents in the upper watershed, therefore, find themselves the target of large dam proposals, which, in turn, threaten their homes and property with condemnation and removal. As a result, the dialogue between lower and upper Yuba watershed residents, agencies and organizations continues to grow more distant, emotionally charged and unproductive. To counter this atmosphere of conflict and discord, the project team offers the YUBA TOOLS proposal to bring stakeholders from the upper and lower watershed together to craft a regional solution that meets the needs of all watershed residents.

APPLICANT QUALIFICATIONS AND LOCAL SUPPORT

The Yuba Watershed Council – a 21-signatory collaborative process successful in attracting \$1.7 million in watershed grants -- collaborated in the development of this proposal and unanimously endorsed Yuba Tools on April 7, 1999. The Nevada County Board of Supervisors lended official endorsement in Resolution 99168 on April 13, 1999. A total of 45 local, state and federal entities have agreed to serve as participants and collaborators. The proposal has also been presented to the Camptonville Proposition 204 Committee and the Lower Yuba Technical Working Group, organizations we will work closely with to generate public participation and stakeholder input. The proposal has also been presented to the Sacramento Bee, the Marysville Appeal Democrat and the Grass Valley Union.

SYRCL, the South Yuba River Citizens League, will serve as the lead for the YUBA TOOLS project. SYRCL is a community-based 501c3 educational organization in its 16th year of operation. SYRCL has close working relationships with local, state and federal agencies and is a leader in watershed issues in both the upper and lower Yuba watershed. SYRCL is joined by Rachel Kamman, of Kamman Hydrology, who is a registered civil engineer with broad experience in surface and sub-surface hydrology.

PROJECT TIMELINE/DELIVERABLES

Phase I includes hiring the project coordinator and technical experts, establishing the stakeholder steering committee and identifying potential watershed management/flood control tools for study. Phase II includes preliminary study and technical

POTENTIAL TOOLS TO MINIMIZE PEAK FLOWS

- ☐ meadow restoration/riparian improvements
- ☐ culvert diversion, wet meadow/recharge basin restoration and other upstream watershed management tools
- ☐ reoperation of existing facilities
- ☐ relocation of facilities out of the floodplain
- ☐ flood bypasses
- ☐ floodplain conservation easements
- ☐ levee raises or setbacks
- ☐ stream meander improvements
- ☐ others... to be determined through public outreach

PROJECT BENEFITS

- ☐ A collaborative *process* to evaluate sustainable flood protection tools;
- ☐ A final *product* identifying goals and priorities for flood control and habitat enhancement and outlines agreed-upon actions and implementation measures.

WATERSHED BENEFITS

- ☐ Protection of life and property from peak flow flooding;
- ☐ Protection of property owners from condemnation by dam development;
- ☐ Groundwater recharge;
- ☐ Recovery of at-risk species;
- ☐ Rehabilitation of natural processes
- ☐ Restoration of functional habitats.



YUBA TOOLS

II-2

99C-118
Panel B

I. Executive Summary

A. Project Description, Primary Biological/Ecological Objectives and Compatibility with CALFED Objectives. Cotton is one of the most widely planted and economically important crops in California's Central Valley. The average one million acres of cotton grown in the Valley produces over one billion dollars in farmgate revenue every year. Unfortunately, cotton production has profound impacts on the environment. In 1998, cotton was identified by the U.S. Environmental Protection Agency's (EPA's) Region IX office as one of the principle crops contributing to environmental and human health problems in the region. In terms of pesticides, cotton is California agriculture's third largest user of agricultural pesticides by weight, and the single largest user of EPA Category 1 and Category 2 pesticides.

Six pesticides that are widely used on cotton are documented as highly toxic to fish, and these pesticides are commonly applied in proximity to the habitats of each water, wetland and riparian-dependent, Bay-Delta Estuary species listed in the CALFED PSP. For example, two of cotton's most commonly applied and most toxic pesticides—chlorpyrifos and metam-sodium—are used in proximity to Splittail and "winter run" Chinook Salmon habitats. Other CALFED priority species that live in cotton proximate habitats include the Giant Garter Snake, the Vernal Pool Fairy Tadpole Shrimp, and the Aleutian Canada Goose.

CALFED itself cites cotton as one of the state's major users of chlorpyrifos, and CALFED has targeted this chemical for reductions through proven management practices (MPs). In fact, half–50 percent–of all the chlorpyrifos used in California agriculture is used on cotton.

The overarching objective of the Sustainable Cotton Project, a non-profit, farmer-based organization, is to reduce cotton farmers' use of agricultural pesticides and fertilizers that are harmful to people, wildlife, and the environment. Through its BASIC (Biological Agricultural Systems In Cotton) program, a program developed in partnership with University of California scientists and local farmers, SCP has enabled farmers to produce 1,000s of no or very low spray cotton in the Northern San Joaquin Valley.

In this proposal, SCP asks CALFED to fund a sustained and significant expansion of the BASIC program in the Northern San Joaquin Valley (Madera, Merced, and Fresno Counties). This area is located within the boundaries of two watersheds that were identified by the California Unified Watershed Assessment as Priority Category I watersheds. Over the next three years, BASIC's target is to convert 35,000 additional acres to BASIC MPs, which will reduce average annual insecticide use on these acres by 80 percent and synthetic fertilizer applications by 50 percent.

B. Approach, Tasks and Schedules. BASIC has many features in common with BIOS, a model in which CALFED has invested over half-a-million dollars to date. Like BIOS, BASIC field management practices favor biodiversity and soil building, and make use of intensive monitoring, thereby enabling cotton farmers to reduce their use of pesticides and fertilizers without increasing farming costs or decreasing quality or yields. Also like BIOS, BASIC is a voluntary, community-based program that uses a farmer to farmer information sharing model. During the three-year project period, SCP's target is to increase by 100 percent each year the number of acres under BASIC management in the Northern San Joaquin Valley (5,000 acres in 1999; 10,000 in 2000; 20,000 in 2001; and 40,000 in 2002), thus significantly decreasing the use of farm chemicals that are damaging to fish and wildlife. Additional targets include fertilizer use reductions and the testing of new, environmentally friendly growing techniques and technologies.

C. Justification for Project Funding by CALFED, Additional Benefits, and Third Party Impacts. In addition to the threatened species mentioned in "A" above, several rivers within the BASIC project area are on the clean Water Act Section 303(d) list and would likely benefit from an expansion of BASIC managed acreage. According to aquatic beneficial use designations, the San Joaquin and Merced Rivers are both impaired by diazinon and chlorpyrifos, and cotton is suspect as a large contributor to this impairment. Cotton uses more chlorpyrifos than any other crop, and agricultural runoff from both late winter storms and summer irrigation return flows has been identified as the principal contamination source of these rivers. Transport of these pesticides via the San Joaquin River contribute to "water column toxicity" in the San Francisco and San Pablo Bays, suggesting that a reduction of cotton pesticide and fertilizer use could have very broad aquatic benefits.

CALFED provides support for the implementation of MPs that offer cost-effective means of reducing off-site movement of pesticides and fertilizers. BASIC's MPs do just this; they are economically viable and have been proven to reduce both synthetic fertilizers and pesticides by an average of 63 percent and 83 percent respectively. BASIC's success on 40,000 acres of cotton will further establish the importance and adaptability of the "BIOS model." Such success will also set the stage for additional expansion of BASIC in other cotton growing regions and facilitate the continued mushrooming of BIOS-type collaborations between farmers, scientists, and PCAs.

D. Budget Costs. SCP is asking CALFED for approximately \$1.39 million over the next three years as follows: \$290,000 year one, \$478,000 year two, and \$621,000 year three. SCP will match 25 percent of all CALFED funding.

E. Applicant Qualifications. SCP has managed the BASIC project since its inception in 1995 and has received support from the U.S. EPA, Cal EPA, individual philanthropists, and leading environmental foundations. BASIC's mentor farmers all reside and farm in the Northern San Joaquin Valley and have substantial experience in successfully producing no or low spray cotton. The project's lead scientist is the director of the University of California's statewide Sustainable Agriculture Research and Education Program.

F. Monitoring and Data Evaluation. Data collection and evaluation is central to BASIC's success. To convince farmers to begin using BASIC MPs, they need to see proof that they can achieve adequate crop yields and quality levels while containing costs. SCP will continue to engage the University of California to monitor these factors. It will also measure all agrochemicals used at each farm to track pollution prevention and watershed protection. Monitoring protocols are all peer reviewed and conform to UC standards.

G. Local Support/Coordination with other Programs. Farmers relate to each other on the basis of long-term familial, regional and community connections. As a result, programs that succeed in these communities usually come from demands within the community. For farmers to change the way they use crop chemicals, they need to see their farm neighbors change their practices successfully. The BASIC program's success to date is largely attributable to its use of local farmers in management positions; BASIC has strategically recruited program participants who are well respected within their communities. In addition to its deep knowledge of farm community dynamics, the BASIC program also has excellent relationships with the Agriculture Commissioners' offices in the project counties, and with cotton scientists at both field stations in the area, University of California's Kerney and USDA's Shafter.

99C-121
Panel A

EXECUTIVE SUMMARY

This project proposal is submitted by the Placer County Water Agency (PCWA) on behalf of the American River Watershed Group CRMP (ARWG). The ARWG is a group of about 26 entities including landowners, business sector interests, environmental groups, special districts, and local, state, and federal agencies interested in addressing and resolving watershed related issues in the watershed of the North, Middle, and South Forks of the American River.

The proposed project is to conduct a paired-watershed evaluation of watershed process and function and of the influences of land use and resource management activities on watershed yield and flow in the very important high elevation headwater areas of the Sierra Nevada. Little information is currently available on the functional processes of these high elevation watershed areas. Recent watershed research has indicated that of the many paired-watershed studies concerning the relationships between land uses and watershed response, essentially none are appropriately applicable to the headwater areas of the Sierra Nevada. This is due to unique seasonal climatic pattern, total annual precipitation, annual variability of total precipitation, and the snowmelt dominated hydrology of the high elevation, physiographic-climatic region of the Sierra Nevada. The objective is to develop important watershed process/function information for watershed stewardship decision-making throughout the target physiographic-climatic region.

The project is located in Placer County in the headwaters area of the MF American River at elevations ranging from approximately 4000 ft. to 7200 ft. It is in portions of the Tahoe and Eldorado National Forests. The paired-watershed to be evaluated are Duncan Canyon (9.9 sq.mi.) and Long Canyon (18.0 sq.mi.), located about six miles apart. Both watersheds have approximately 30 years of stream gage data and an initial review of the gage data indicates that flows in the relatively undisturbed watershed are greater than those in the highly disturbed watershed by as much as 60% during the snowmelt period and 500% greater in the summer baseflow period. The gage data spans a period of record that includes multi-year low and high wateryear cycles and a full range of intermediate wateryears. These climatic conditions will facilitate the applicability the project results.

The primary ecological/biological objectives of the project is 'to improve upper American River watershed health by implementing improved practices' (ERP Vol2. p.325). Third party impacts are all positive in that progressive implementation of project result will lead to improved watershed practices in the Sierra watersheds tributary to Central Valley streams and the Bay-Delta system. Improved flows, water temperature, and water quality parameters will result in improved background conditions as well as improved success potential and effectiveness of other restoration actions. The project is compatible with CALFED objectives and will make contributions to overall CALFED success.

As this is a research, information development, and outreach project there are three main aspects that will be subjected to monitoring; research, application, and outreach. The PRMS design and the hydrologic and climatic data, and hydrologic attribute findings will be reviewed by

the USFS and the USGS for technical competence before the application of the PRMS will commence and structural development of the HRUs will be reviewed for attribute adequacy by the USFS and the NRCS and reviewed for scale and refinement suitability to stewardship applications by the USFS, NRCS, PCRCD, and the landowner and business sector interests in the ARWG. To facilitate an appropriate watershed assessment and information types that will meeting the needs of various entities there will formal workshop secessions early in the PRMS application phase in which all potential user entities (USFS, NRCS, RCD, county planning/public works, landowners, business interests, etc.) will assist in developing application targets. To ensure that the project products are usable and useful a formal workshop will be held with probably applicants of project results (USFS, NRCS, RCD, county planning/public works, landowners, business interests, etc.) to develop an overall framework for the outreach and information dissemination vehicles.

To ensure that these monitoring and input mechanisms guide and direct the structure and execution of the project these review and workshop milestones will be scheduled at the commencement of the appropriate project phases.

Project costs are \$109,600. Requested CALFED funding is \$83,600. Pending project approval, the following in kind labor contributions have been committed to the project: PCWA, \$10,000; USFS \$8,000; NRCS, \$2,000, and; PCRCD, \$2,000.

The ARWG is currently initiating a "NF/MF American River Watershed Plan and Stewardship" planning program for those two forks of the American River funded by CALFED. Due to the large area of assessment for the on-going NF/MF American effort and budget limitations, that effort is limited to the coordination and use of existing resource information and non-modeling analytic approaches to watershed assessment. The ARWG has identified a need and an opportunity to conduct the Duncan/Long Canyon paired-watershed project using more detailed resource information and hydrologic/watershed modeling to both facilitate the larger scale watershed planning effort by assisting in identifying the types of watershed resource attributes to consider and to provide a detailed understanding of headwater watershed process for direct on the ground application toward watershed planning, stewardship, and land use decision-making. The ARWG and the above mentioned specific agencies have submitted letters of support for this project.

The project will be managed by PCWA, as the applicant, but will be executed by PCWA, the Tahoe and Eldorado National Forests, local Resource Conservation Districts, the NRCS, landowner representatives on the ARWG, and watershed planning and engineering specialists. The design approach to engage these entities throughout the project is to ensure that the project is directed toward results that are useful to watershed stewardship decision-making at all levels and the project results are structured to applicable to the needs and responsibilities of these entities throughout the target physiographic-climatic region.

Water Quality Recommended For Funding

Prop. No.	Project Title	Applicant Organization	Recommended Amt.
99-D113	Chronic Toxicity of Environmental Contaminants in Sacramento Splittail: A Biomarker Approach	UC Davis, Dept of Animal Science	\$673,684
99-D116	Assessment of Pesticide Effects on Fish & Their Food Resources in the Sac-SJ Delta	UC Berkeley, Regents of the University of California	\$1,875,561
99-D119	Determination of the Causes of Dissolved Oxygen Depletion in the SJ River	CA Dept of Water Resources, Environmental Services Offices	\$866,408
99-D123	Dissolved Organic Carbon Release from Delta Wetlands, Part 1	US Geological Survey, Calif State University, MS 6129	\$1,392,669

1. Executive Summary

Chronic Toxicity of Environmental Contaminants in Sacramento Splittail (*Pogonichthys macrolepidotus*): A Biomarker Approach

Silas Hung Ph.D., Swee J. Teh Ph.D., and Jay A. Davis PhD

The maintenance of a population of fishes is heavily influenced by the constantly changing physical and biological conditions of the ecosystem. Contaminant stress may compromise the ability of fish to survive natural environmental stressors. Ultimately, fish populations that are unable to compensate for additional stress will show reductions in growth, reproductive capacity, and survival. For a species that has already declined drastically, survival and reproductive success have profound ecological significance. When exposed to various stressors such as from contaminants, the fish may not even survive to carry out the ultimate function of reproduction. Furthermore, chronic dysfunctions of reproduction in the surviving fish might ultimately result in decreased fecundity and fertility, and thus indirectly impacting the population level. Although water quality deterioration, water diversions, and habitat loss and degradation (all resulting from human activity) may have contributed to declines in fish population, there is a high degree of certainty that splittail population is adversely affected by exposure to contaminants from commercial, domestic, and agricultural sources. However, integrated laboratory and field investigations using biomarker approach to detect and quantify chronic contaminant responses in splittail are lacking.

The Sacramento splittail (*Pogonichthys macrolepidotus*), a Federally listed threatened species, forages on benthic organisms. Splittail are now largely confined to the Sacramento-San Joaquin Delta, Suisun Bay, Suisun Marsh, the Napa River, and the Petaluma River except during spawning migrations in winter and spring (Meng and Moyle, 1995). Juvenile remain in the river system for weeks to a year before migrating to the delta where they mature at age 2. Adult fish remain in the bay-delta system year round but will migrate upstream to spawn in fresh water preferably over flooded vegetation. Unlike other native fish species where laboratory culture is difficult and expensive, splittail is easily cultured at low cost and will spawn in captivity providing access to all life stages. Therefore, we propose to use splittail as a native fish model for chronic toxicity study.

We will demonstrate the use of biomarkers (biological responses), in conjunction with ongoing biomonitoring efforts of fish population by DFG and water, sediment, and tissue contaminant monitoring by SFEI and USGS, to evaluate the chronic effects of contaminants on the health of splittail under laboratory and field conditions. Four functional categories of biological indicators will be measured: 1) indicators of contaminant exposure, 2) indicators of general condition indices, 3) indicators of organ and reproductive dysfunction, and 4) indicators of individual-level response. We propose to evaluate a suite of biomarkers of exposure and effect indicators at several levels of biological organization to quantitatively: 1) assess the potential chronic effects of contaminant exposure on various life stages of splittail under laboratory and field settings, 2) establish a link between the contaminant exposure and the deleterious health (growth and reproduction) of individual splittail, and 3) identify indicators of contaminant exposure that are most cost-effective for use in future monitoring studies. This will provide valuable information for future environmental compliance and regulatory studies and the ecological risk assessment process. These studies also have practical application as laboratory data linking specific contaminants with adverse chronic effects (as well as field data correlating biomarker expression with contaminant exposure) that could help guide management decisions with respect to determining acceptable contaminant levels in the environment.

Three tasks will be conducted simultaneously for three years. In task 1, we will investigate

adult and juvenile splittail from several field sites and compare a range of biomarkers of exposure and adverse effects in individual splittail as a function of the site. Concentrations of mercury (Hg), selenium (Se), diazinon, polychlorinated biphenyl (PCBs), and organochlorine pesticides will be measured in gonads and whole bodies of 5 fish from each site. This chemical monitoring will be closely integrated with other SFEI projects (RMP, SRWP, CISNET, and fish sampling for the CALFED designated action on mercury) that will provide additional information on concentrations of these contaminants in water, sediment, and fish tissue at some of the study locations. Embryos will be collected and grown in a clean environment for developmental toxicity study. We will select sites along the Sacramento River, the Sacramento River in the vicinity of the Yolo and Sutter bypasses, and Suisun Bay/marsh where contaminants such as Se, Hg, diazinon, pyrethroid, and PCBs are known to be present.

In task 2, we will investigate a range of biomarkers of exposure and adverse effects in laboratory-raised splittail. We plan to expose all life stages (embryo/larvae, juvenile, and adult) to one or several reference toxicant(s) at concentrations within the range determined in field samples. Laboratory exposures will be 7 days for embryo and 30 days for juvenile and adult. Metals (selenium and mercury) and pesticides (diazinon and pyrethroid) will be used. After exposure, all fish will be transferred to clean water. Embryo and juvenile groups will be sacrificed at Day 0, 7, 14, 21, and 28 post exposures. Adult groups will be sacrificed at day 0, 90 and 180 post exposures.

In task 3, we will review existing contaminant-related literature pertaining to our experiments on splittails. Correlation of the integrated biomarker of responses and the spatial patterns of contaminant concentrations in tissue, water, and sediments will be determined using multivariate statistical analysis. Write and submit quarter and annual reports of findings to CALFED. Manuscripts from the proposed research will be submitted to a high quality scientific journals for peer review and publication. Results will be disseminated widely through participation in workshops and seminars, and presentation of papers at an international/national meeting.

Dr. Silas Hung has 20 years experiences in fish rearing and nutrition under laboratory condition. Dr. Swee J. Teh has 12 years of extensive field and laboratory research experience on ecotoxicology and biomarker study. He has also experienced in projects and experimental design and managing contracts and grants' total >\$1 millions per year. Dr. Jay Davis assists with management of the Regional Monitoring Program for the San Francisco Estuary and is the principal investigator in several studies of fish contamination in the Sacramento River, the Delta, and the Bay. Our experience in field sampling and evaluation, biomarker approach, aquatic toxicology, biochemistry, fish nutrition, fish pathology, and husbandry will facilitate completion of this study.

Local support/coordination: This project support ongoing efforts by the USFW Service and the IEP in recovering threatened and endangered fish populations in the Sacramento-San Joaquin system by facilitating restoration planning and monitoring. We will be working with DFG's splittail monitoring survey, IEP funded splittail culturing projects, and various water quality monitoring programs (e.g. DFG, SWRCB, SFEI, USGS)

Budget Costs and Third Party Impacts: To ensure the completion of this combined field and laboratory chronic toxicity study, we are requesting a total funding of \$ 673,684.00 for three years. Task 1 and 2 can be separated if funding is limited.

There are no third party impacts.

99D-116
Parcel B

EXECUTIVE SUMMARY

Abundant evidence exists for the presence of significant amounts of pesticide residues in the Sacramento River, San Joaquin River, and Delta and concurrent toxicity to invertebrate species used in standard toxicity tests. While this result is cause for concern, there is disturbingly little data by which to assess effects on local populations of fish and invertebrates in the rivers and associated sloughs. Nearly all work to date has focused on toxicity testing using nationally standardized tests, most commonly with the cladoceran *Ceriodaphnia dubia*, rather than resident species. Moreover, attempting to compare pesticide concentrations to published toxicity data does not take into account local conditions like interactive effects of multiple pesticides, acclimation or sensitization due to prior pesticide exposure, or bioavailability limitations, all of which can dramatically alter an expected level of toxicity. Finally, past work has regarded the invertebrate toxicity test organism as merely a monitoring tool, rather than putting results in an ecological context by considering how impacts to one species may affect others in the environment that depend upon it, such as fish predators. We are proposing an integrated laboratory and field study with the objectives of providing information on pesticide toxicity to resident species, developing the data needed to apply laboratory-derived toxicity measures to realistic field conditions, and putting results in an ecological context focusing on juvenile chinook salmon and their prey.

Work will be conducted over a three year period. Initial tasks will be laboratory studies meant to improve interpretation of toxicity testing results by putting classical toxicity testing in a more environmentally realistic context, then the lessons learned will be tested in two field seasons.

Task 1 - As an initial step we will review the Department of Pesticide Regulation data base on pesticide use, monitoring data from the Delta and lower Sacramento/San Joaquin, and general toxicity literature. The outcome of this task will be a list and supportive documentation of pesticides (including herbicides) that are used in the Central Valley, demonstrated or likely to be in Delta waters, and present at potentially toxic levels either solely or in an interactive fashion with other substances. These priority pesticides will be the focus of all later lab and field work.

Task 2 - We will screen resident species as to their suitability for toxicity testing, and fully develop testing protocols for the preferred organisms with emphasis on sublethal endpoints. One of the principal invertebrate groups we will focus on are arthropods because of their presumed greater sensitivity to pesticides. We will also develop toxicity testing protocols for chinook salmon embryo and juveniles using both lethal and sublethal endpoints. Biomarker development will be incorporated in this task, emphasizing endpoints such as immune system effects and acetyl-cholinesterase activity, which are either clearly pesticide linked and/or have obvious adverse consequences for the organism.

Task 3 - As a prelude to later field application, we will refine Toxicity Identification Evaluation (TIE) procedures for several resident invertebrate species identified in Task 2, and establish TIE profiles as needed for the priority pesticides identified in Task 1.

Task 4 - Pesticide toxicity has invariably been evaluated based on exposure to a single substance, when in fact an aquatic organism is likely to be exposed to many pesticides simultaneously. In this task we will screen binary combinations of the priority pesticides for interactions, and when established, develop dose-response data for concurrent exposure to the two pesticides. The results will aid in the interpretation of field data when unexpected toxicity (or lack thereof) is attributable to pesticide synergism or antagonism.

Task 5 - An animal's sensitivity to a given pesticide exposure may be a function of historical exposure that makes the individual more sensitive to or tolerant of repeated exposure. We will define realistic pulse profiles (duration, magnitude and frequency) to which Delta organisms are likely to be exposed, and determine the effect of this exposure on pesticide tolerance.

Task 6 - Association with dissolved organic matter (DOM) or suspended particles may lessen the bioavailability of the more hydrophobic pesticides such as chlorpyrifos. By manipulating DOM concentrations we will examine its effect on pesticide toxicity, and determine if concurrent measures of DOM quantity/quality would substantially enhance interpretability of field pesticide data. We will

also establish if pesticides adsorbed to particulate matter can be viewed as non-bioavailable, or if desorption into the dissolved phase occurs at a rate fast enough to contribute to water column toxicity.

Task 7 - Throughout at least Jan-March (and potentially beyond) in two years we will conduct field work at about 4 sites within the Delta. The selection of these locations will be made after a comprehensive literature review and preliminary sampling earlier in the project period, but it is our current intention to locate 1-2 sites in the mainstem rivers (Sacramento/San Joaquin) and locate the remainder of the sites in creeks or sloughs representative of specific source types (e.g. orchards, urban runoff). At all sites we will characterize pesticide concentrations on a daily basis during high flow events and weekly otherwise. We will perform laboratory toxicity tests using the resident species protocols we have developed, and conduct TIEs to establish the causative agent. We will also conduct in situ toxicity tests during high flow events using hatchery-supplied juvenile salmon, measuring survival, growth, and suitable biomarkers such as immune system effects and acetylcholinesterase inhibition. Our intent is to use this data set to field validate the results of the prior laboratory studies on pesticide interactions, multiple pulses, and bioavailability. The field work will include stomach content analyses of juvenile fall-run chinook salmon collected by USFWS in order to: 1) select appropriate resident invertebrate species for toxicity test development in light of their food value to salmon; 2) evaluate the plasticity of salmon prey selection as pesticides and/or other high flow-related factors change food availability; and 3) establish how quickly a population eliminated during a high flow event recovers in density and reappears in the diet. In addition, we will characterize the diet of other CALFED-priority species such as Delta smelt, winter-run chinook, and splittail to the extent they are available (e.g., incidental collection mortalities), but their availability is limited due to their protected status and USFWS take restrictions.

Task 8 - Finally, we will present the results in a format intended for use by environmental managers. We will prepare recommendations based on the laboratory and field results on how to monitor pesticides and toxicity in the Delta including such things as a list of pesticides of concern within specific watersheds, resident species that have proven successful for routine monitoring, frequency of sampling during and between storm events, and ancillary variables needed to predict bioavailability.

Our proposed studies seek to take toxicity testing beyond its use as a monitoring tool, and into an ecological context by focusing on fish and their invertebrate prey. Direct pesticide toxicity to fish in the Delta is a possibility, and our laboratory exposures of salmon and in situ salmon toxicity tests are specifically designed to address that issue at both a lethal and sublethal level. Indirect effects through changes in food abundance, however, are also of concern, and our invertebrate toxicity testing will be done with that perspective. Extensive stomach content analysis is planned specifically to guide and justify our choices of resident invertebrates.

Our project team brings to the study unique and broad qualifications, and most importantly, unparalleled research experience on pesticides and pesticide toxicity in the Delta. The UC Davis Aquatic Toxicology Laboratory has done the majority of toxicity testing and TIE work in the Delta, and Dr. Werner's research has focused on the development of chronic or sublethal indicators of toxic effects as is intended in these studies. DeltaKeeper is already conducting pesticide monitoring in the Delta and their results will benefit this project. Members of their organization have an intimate knowledge of the Delta system that is unmatched. Dr. Kuivila at USGS is well-recognized for her analytical work on pesticides in the watershed. Dr. Weston has worked extensively on environmental and organismal factors affecting bioavailability, and the development of chronic toxicity tests. Dr. Lydy's research has specialized on pesticide interactions, and especially those involving organophosphates. Our combined experience allows us to build upon our on-going work, much of it in the Delta, of immediate and direct relevance to the proposed studies

Executive Summary

Description of Project: This project will produce a management action plan to eliminate the oxygen depletion in the San Joaquin River during the fall.

Many point and non-point sources and physical factors have been attributed to cause of the oxygen depletion in the river, but available data and modeling tools have been inadequate to develop a reliable and efficient management action plan.

The management action plan will be developed over 3 years and will include: 1) development of a database containing new and historical data on source loads of oxygen depleting substances, 2) collection of supplemental field data on source loads and controlling mechanisms, 3) filling data gaps in the existing dissolved oxygen management model for verification and calibration of controlling factors, 4) evaluation of management alternatives and 5) development of a management action plan.

Problem: Dissolved oxygen depletion occurs over a 10 mile reach of the San Joaquin River near Stockton in the fall when concentrations decrease below 6 mg/l; concentrations below 2.5 mg/l are common (USBR 1968-1974; CDWR 1987-1995; Jones and Stokes 1998). Dissolved oxygen concentrations below 6 mg/l are ecologically damaging because they are a barrier to upstream migration of adult fall-run Chinook salmon that spawn in the Merced, Tuolumne and Stanislaus Rivers between September and December (CDFG 1970). The San Joaquin salmon population has severely declined and is considered a "species of concern" by the US FWS and was listed as a threatened species by NMFS. Low dissolved oxygen concentrations can also kill, stress or block migration of other fish and may negatively impact the health of the entire aquatic community (CVRWQCB 1997).

Compatibility with CALFED: Oxygen depletion in the San Joaquin River is considered a significant water quality problem in the CALFED Estuarine Restoration Program (ERP) and impedes the CALFED goals to: 1) recover at-risk species in order to establish self-sustaining populations and minimize the need for future endangered species listings, 2) rehabilitate natural processes that support natural aquatic communities and favor native communities and 3) improve and maintain water and sediment quality to eliminate toxic impacts on organisms in the ecosystem. Oxygen depletion in the San Joaquin River is a focused action for this proposal package.

This project is directed toward the ERP target species, fall-run Chinook salmon and will assist with CALFED Water Quality Program goals to: 1) eliminate occurrences of dissolved oxygen concentrations below 6 mg/l in the fall, 2) eliminate the impairment or blockage of fish migration, 3) eliminate stress to fish and other aquatic organisms due to oxygen depletion, and 4) eliminate fish kills near Stockton.

These goals also interface with Title 34 of the CVPIA and the program for restoring anadromous fish populations outlined in "Restoring Central Valley Streams: A Plan for Action" (CDFG).

Monitoring and Data evaluation – The primary objective of the project is to fully evaluate our current conceptual model of the causes of the dissolved oxygen depletion near Stockton in order to design a management action plan to eliminate the problem.

The current conceptual model is that algal biomass from the San Joaquin River upstream of Mossdale, sediment deposits and Stockton treated effluent are major sources of oxygen depleting substances in the San Joaquin River and that these sources become a problem in the fall when water.

temperature is high and streamflow is low. Current information, however, is inadequate to fully evaluate this conceptual model and allocate the loads among potential sources for management.

We will evaluate the conceptual model by direct field measurements and modeling results. Continuous fluorometry and simple mass balance calculations will directly measure the transport of algal biomass from Mossdale to the oxygen depletion zone. We will verify the relative contribution of both living and dead algal biomass from Mossdale to the oxygen demand in the oxygen depletion zone using biomarkers. The percent contribution of algal biomass to the total load of oxygen depleting substances will be determined from measurements of BOD, COD, chlorophyll *a* concentration, TOC, nutrients, biomarkers and flow from urban, industrial and agricultural sources throughout the upper and lower San Joaquin River. These surface water loads of oxygen depleting substances will be compared with direct measurements of organic and inorganic oxygen depleting substances in the sediment (sediment oxygen demand). Field sampling will begin at locations known to be important from historical data.

New and historic data on surface and sediment sources of oxygen depleting substances and associated physical and chemical data will be used to fill data gaps in the existing dissolved oxygen management model and enhance calibration and verification of controlling mechanisms. Comparison of new and historical field data with modeling results will provide insight for evaluation of alternatives and best management practices needed for development of a management action plan. Development of an IEP database and CD disk version of the model will make the model and data readily available to Stakeholders.

Field data collection and analyses will be done with the guidance of a statistician and field and laboratory analyses will be done using US EPA QA/QC guidelines.

Local support – This proposal was developed with the support of the SJR Dissolved Oxygen Steering and Technical Committees which represent these urban, agricultural, industrial and government stakeholders: 1) cities - Stockton, Manteca, Lathrop, Lodi, Merced, Turlock, Tracy and Modesto, 2) Farm Bureau, 3) government agencies - CDWR, CDFG, RWQCB, US EPA, USFWS and USDA, and 4) environmental groups represented by the Delta Keeper.

Coordination – Field sampling will coordinate with existing USBR/CDWR, CDFG, USGS, RWQCB and RWCF sampling programs. The project will also collect water quality data for the CALFED funded fish passage study (CDFG) and will collaborate with the CALFED funded program on sediment transport in the Delta (USGS).

Applicant qualifications – Project elements will be conducted by experts from academia, state and federal governments and consulting firms that have experience in the region. Investigators will be guided by local experts through the SJR Dissolved Oxygen Technical and Steering Committees, local peer review from IEP Project Work Teams, the Bay-Delta Modeling Forum and an outside review team.

Third party impacts - Third party benefits include a) improvement of water quality for south Delta agriculture and drinking water for southern California, accessibility of upstream habitat availability and reduction of mortality and stress of salmon and other aquatic organisms in the San Joaquin River and removal of impediments to growth in the San Joaquin River Basin.

Cost - Phase I (year1) - \$871414 ; Phase II (year 2) - \$750886; Phase III (year 3) - \$750886. These costs include a 20% indirect cost to manage the contract through the CSUS Foundation. Advance billing instead of arrears billing would reduce this indirect cost to 15%.

Executive Summary

BACKGROUND:

Rivers, wetlands, and agricultural operations supply organic material to the Sacramento-San Joaquin Delta and San Francisco Estuary – essential nutritive material supporting the aquatic foodweb. Unfortunately, the presence of high concentrations of organic material cause public health concerns. Delta waters are currently used by over 22 million people for drinking water. When treated with disinfectants such as chlorine or ozone, dissolved organic carbon (DOC) and naturally occurring bromide in water can form carcinogenic disinfection byproducts (DBPs). The concentration of DBPs in drinking water is stringently regulated by US EPA.

CALFED ecosystem restoration activities seek to restore wetland habitat and provide sources of organic material beneficial to the Bay and Delta foodweb. While as many as 100,000 acres may be converted to wetland habitat in the Delta, it is not known if these wetlands will alter the concentrations of organic material prone to forming DBPs. The primary goal of this research is to provide the scientific information that will allow CALFED to maximize the ecological benefits of new wetland habitat while minimizing sources of organic material that would adversely impact Delta drinking water quality. An example of how this might be accomplished would be to restore only specific types of wetlands – those exporting small quantities of deleterious organic carbon – on flow paths affecting drinking water intakes.

At present, there is little information available regarding the amount or quality of organic material released from different types of wetlands (or even agricultural sources) and its effect on either the Delta foodweb or drinking water treatment. Consequently, the following 5 questions, listed in order of importance, have been identified by CALFED as the highest priority information needs for assessing the potential effect of ecosystem restorations on dissolved and total organic carbon (DOC, TOC) levels in the Delta:

- "1. How much and what forms of TOC do wetlands generate?"*
- "2. To what extent is TOC released from wetlands altered and consumed in Delta waters?"*
- "3. By comparison, how much and what forms of TOC are released from agricultural activities?"*
- "4. What wetland management strategies may be used to limit introduction of TOC into Delta waters?"*
- "5. How will the impacts of restored wetlands change in the future as they mature?"*

APPROACH:

To answer each of these questions, independent information is needed about both the **form** of TOC and the **amount** of TOC released from various wetlands and agricultural operations. TOC is made up of particulate (POC) and dissolved organic carbon (DOC). The chemical composition – the form of TOC – varies widely, and different forms of TOC react to produce different amounts and types of DBPs. The form of the TOC also affects the potential foodweb benefits because different forms are utilized to different degrees. The amount of TOC released by different land uses (such as different wetlands) also varies widely.

This proposal focuses on issues related to the **form** of TOC, examining a variety of representative wetlands, rivers, and agricultural sites. We chose to submit a companion proposal that quantifies TOC export from a single wetland and agricultural site since determining the **amount** of TOC exported is an expensive and difficult task that requires using a different technical approach. Together with results from a previously funded CALFED study examining particulate

organic carbon (POC; J. Cloern), these two proposals will provide a quantitative basis for estimating the relative contributions of TOC from different wetlands into the Delta, and permit an accurate comparison to current agricultural activities. This proposal focuses on DOC because it is the dominant form of organic matter exported from wetlands to Delta Channels and is the most likely to form DBPs. When complete, these projects will integrate with the existing CALFED study of POC and provide a comprehensive assessment of TOC in the Delta system.

The goals of this project are to: 1) characterize the concentration and quality of DOC released from different wetland types within the Delta and by agricultural activity, assessing both incorporation into Delta foodwebs and public health concerns that arise when Delta waters are used as drinking water; and 2) determine how microbial alteration affects the quality of the DOC and thus changes the concentration of the small fraction of DOC causing public health concerns.

STUDY DESIGN:

Past research on DOC in Delta waters indicates that: the source of DOC is a key factor for both ecosystem and drinking water concerns. For drinking water, it is known that only a small fraction of DOC forms DBPs; that concentrations of precursors vary by 10 fold depending on location within the Delta; and that DOC concentrations vary by 10-20 fold across the system. The amount of precursors in the DOC is highly dependent on the source and extent of degradation of the organic material. Similarly, the source and quality of the organic carbon is important to the microbial part of the foodweb as it determines the intrinsic lability and nutritive value. In addition, DBP precursor formation is linked to microbial use and degradation of DOC.

We propose to separately characterize the DOC from different Delta sources to understand how DOC released from wetlands is incorporated by microbes for eventual transfer to higher trophic levels (copepods, cladocera, rotifers, mysids and fish or species of special concern). Simultaneously, we will examine changes in chemical composition before and after microbial degradation, as they relate to DBP formation potential. When coupled with accurate physical modeling, these results will provide a quantitative basis for estimating the impacts of restoration efforts on organic carbon supply to the Estuary and to drinking water intakes.

This study will first survey a variety of representative wetlands over the seasons to determine the extent to which wetland-derived DOC forms DBPs, and the extent to which wetland-derived DOC forms DBPs and causes other difficulties in the treatment process. Next, it will explore bioutilization of this material and the extent to which DBP formation by DOC from different sources is altered by natural processes such as microbial degradation and photolysis. Finally, it will relate the composition and reactivity of the DOC to landscape-level features and environmental factors within the wetlands.

For a comprehensive examination of these issues, we have assembled a team of scientists who will employ an array of scientific tools. The team will be led by Brian Bergamaschi of the U.S. Geological Survey. He and J. T. Hollibaugh will bear responsibility for all scientific products. The various team members bring a wealth of scientific experience in microbial degradation, photolysis, carbon release from peat soils, wetland ecology, chemical characterization of natural organic material, organic geochemistry, application of isotopic techniques to foodweb interactions, drinking water treatment, and the chemistry of DBP formation. The progress and products of the study will be monitored by an independent scientific advisory panel composed of internationally recognized experts in DOC release from wetlands, chemical characterization of DOC, aquatic foodweb interactions, drinking water treatment, and DBP formation. The final reports will analyze and synthesize the experimental results to identify specific options to CALFED regarding the potential impacts of different restoration actions on Delta drinking water quality and DOC-supported biological production in the Delta.

Introduced Species Recommended For Funding

Prop. No.	Project Title	Applicant Organization	Recommended Amt.
99-E101	An Evaluation of the Potential Impacts of the Chinese Mitten crab on the Benthic Comm. in the Delta	CA Department of Water Resources,	\$147,799
99-E103	Effects of Introduced Species of Zooplankton & Clams on the B-D Food Web	San Francisco State University: Romberg Tiburon Center	\$726,930
99-E104	Assessing Ecological & Economic Impacts of the C. Mitten crab	UC Berkeley, Regents of the University	\$149,429
99-E116	Purple Loosestrife Prevention, Detection & Control Actions for the Sac/SJ River Delta System	CA Dept of Food & Ag, Integrated Pest Control Branch	\$127,473

Executive Summary

Project Title: An Evaluation of the Potential Impacts of the Chinese Mitten Crab (*Eriocheir sinensis*) on the Benthic Community in the Sacramento-San Joaquin Delta and Suisun Bay

Applicant Name: Leo Winternitz and Cindy Messer, Department of Water Resources

Project Description and Primary Biological/Ecological Objectives:

The purpose of this project is to provide information regarding the relationship between the Chinese mitten crab (*Eriocheir sinensis*) and the benthic invertebrate community within the Sacramento-San Joaquin Delta and Suisun Bay. Benthic invertebrates make-up a large part of the Delta aquatic food web. Adverse impacts to the benthic invertebrate food supply may impact survival and productivity of fish and shorebirds. Both native and non-native priority species that may be affected include: chinook salmon, striped bass, white sturgeon, signal crayfish, grass shrimp, splittail and warmwater game fish (ERPP, Volume 1 pp.349-350).

This project will be comprised of nine study sites. The project area includes: Suisun Bay, the Sacramento River (up to the Rio Vista Bridge), the San Joaquin River (as far east as Buckley Cove) and Old River (near the intake to Clifton Court Forebay). The scientific hypothesis that this study will evaluate is: The Chinese mitten crab has an adverse effect on benthos species diversity and abundance in the Sacramento-San Joaquin Delta and Suisun Bay. The primary biological/ecological goals of this project are to determine whether the presence of the Chinese mitten crab in the Sacramento-San Joaquin Delta has an adverse effect on benthic species diversity and abundance and to determine relative abundance of both juvenile and adult crabs at each study site in an effort to estimate Delta-wide relative abundance and distribution during a 14-month period. Other benefits include the opportunity to review the efficiency of several different sampling methods for collecting mitten crabs, which will aid in the development of a trapping system used to control this invasive species. The diverse nature of the study sites, as well as the different habitat types these sites represent should help further our knowledge on habitat preference of migrating and resident mitten crabs. This project will also provide some information regarding the relationship of the mitten crab to a native species of grass shrimp (*Cragnon franciscorum*) and a non-native species of crayfish (*Pacifastacus leniusculus*) which support a small commercial fishery in the system. Primary habitats that this study will examine are tidal perennial aquatic habitat, delta sloughs, shoals, and freshwater habitat.

Monitoring and Data Evaluation:

Benthic monitoring will be conducted using a Ponar dredge. Otter trawling and modified crab traps will be used for mitten crab monitoring. Direct impacts to the benthic community will be investigated using an enclosure study and examination of stomach contents of the crabs. Data will be collected over a fourteen-month period. This study will attempt to detect both short-term and long-term changes in the benthos. Short-term changes (seasonal) will be evaluated by comparing data before, during and after migration of the crabs through the study area. Long-term changes will be evaluated by comparing data collected by this study to historical data collected by DWR from 1975 to the present.

Applicant Qualifications:

Leo Winternitz has a graduate degree in Environmental Management and is currently an Environmental Program Manager I with DWR. His relevant experience includes: administering major portions of the \$2 million Sacramento-San Joaquin Ecological Studies Project Agreement between DWR and DFG; participating as a member of the Delta Native Fishes Recovery Team chaired by Dr. Peter Moyle whereby recovery objectives for seven species of native fish were developed; acting as DWR's program manager for the Prospect Island Restoration Project; supervising the Interagency Program Section of the Ecological Studies Branch within DWR for five years; and currently overseeing the Monitoring and Analysis Branch of DWR's Environmental Services Office which includes the Bay-Delta Section and the Water Quality Control Systems Section.

Principal investigators of each of the monitoring elements were selected based on their areas of expertise. They include environmental specialists from DWR, a statistician from USGS and an aquatic biologist from Hydrozoology, Inc.

Budget Costs and Third Party Impacts:

Overall cost for this proposed study is \$211,960. However, combining this proposed study with DWR's in place Water Quality Monitoring Program results in a cost savings of \$64,161, due to savings in boat time, sample analysis, materials, and staffing. Therefore, we are requesting that Category III fund the remaining \$147,799 of this study. There are no known adverse impacts to third parties.

Local Support/Coordination with Other Programs/Compatibility with CALFED Objectives:

All counties in which this study will take place have been notified by letter of our intent to submit a proposal. Through the Interagency Ecological Program monitoring will be coordinated between this project and various project work teams. This study will be closely linked to the D-1485 Water Quality Monitoring Program conducted by the Department of Water Resources, Department of Fish and Game and the U.S. Bureau of Reclamation. This relationship involves the use of identical benthic sampling procedures, as well as equipment and personnel. Long-term benthic data obtained from the D-1485 program will be compared with data gathered by this project and used to establish impacts from the mitten crab. This mitten crab study will also collaborate with the Chinese Mitten Crab Habitat Use Project scheduled for implementation by DWR (with funding from IEP) starting in spring 1999.

Mitten crab monitoring described in this proposal is compatible with CALFED's ecological objectives in that it will examine the effects on food-web production by a non-native invasive species. This project will provide initial data on feasible means of non-destructive capture and control of mitten crabs, and will improve our understanding of how this invasive aquatic organism is affecting the ecological processes and species interactions within the Sacramento-San Joaquin Delta.

This project will also provide benefits for CALFED's non-ecosystem objectives by providing useful information for water pumping facilities on potential crab control measures and crab distribution and movement within the Delta. It may also provide useful information regarding distribution for individuals and organizations looking into the effects of burrowing mitten crabs on levee integrity.

1. Executive summary

We propose a research project on the effects of introduced species in the food web supporting several fish species of concern of the San Francisco Bay-Delta estuary. The research will focus on the early life stages of delta smelt, longfin smelt, and striped bass.

The estuarine ecosystem has been greatly altered through introductions of exotic species which may limit the effectiveness of rehabilitation actions. Most of the alterations have occurred in the lower foodweb, and effects on the lower foodweb are reasonably well-understood. What remains unknown, and is the topic of our research, is how these foodweb alterations influence the key fish species that depend on that foodweb, and what rehabilitation actions might be effective in the context of the altered foodweb.

CALFED documents justifiably emphasize rehabilitation actions in preference to research. However, for fish species of concern in open waters of the estuary, few actions have been identified, and none with much certainty about their effectiveness. The reason is the lack of knowledge about the function of this ecosystem, the likely outcome of different, alternative actions, and the role that introduced species have in limiting options for rehabilitation. Our proposed research will fill key gaps in knowledge and help to suggest ideas for actions that might result in improvements for these key species.

CALFED Ecosystem Restoration Program documentation strongly supports the need for research on effects of introduced species on the estuarine foodweb. First, the Strategic Plan for Ecosystem Restoration includes as Goal 5 prevention of establishment of non-indigenous introduced species (NIS), and reducing their negative biological and economic impacts, but the negative impacts of NIS in the estuary have yet to be determined. Second, according to Strategic Plan Goal 2, the ecosystem is to be rehabilitated through the use of natural processes to support native species. However, we understand very poorly the capacity of the estuarine ecosystem to support natives, and how the numerous introductions have altered this capacity.

The need for research on the effects of NIS is spelled out repeatedly in CALFED ERP documents. For example, *"...it is important to initiate an early program that: ... develops a better understanding of how non-native species affect ecological processes and biological interactions, ..."* (Strategic Plan). *"A major obstacle to solving problems of estuarine productivity is our poor understanding so solutions will have to come from research and monitoring ..."* (ERP Vol. 1 p. 46). *"(The reduction in estuarine foodweb productivity) implies a limit on the extent to which Bay-Delta fish populations can be restored unless creative solutions can be found to increase foodweb productivity"* (ERP Vol. 1 p. 98).

The creative solutions called for have not yet been found, to our knowledge. Thus, the need for the research that we propose has been clearly indicated by the CALFED ERP,

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and is clearly supported by the current state of scientific knowledge about the estuarine foodweb.

The objectives of the proposed research are to answer the following questions:

1. *How has the Asian clam *Potamocorbula amurensis* altered the feeding environments of fish species of interest?*
2. *How are native and introduced zooplankton species used as food by these fish?*
3. *What are the competitive and predatory relationships among the native and introduced species that explain their persistence?*
4. *What is the production rate of food, both native and introduced, for young fish in the Bay/Delta, and could it be increased?*

The three species of fish were chosen not only for their importance in restoration of the estuarine ecosystem. They also provide a contrast in life histories and likely responses to environmental conditions and introduced species, particularly the clam *P. amurensis*. This contrast should enable us to distinguish among responses to these influences.

We plan to emphasize the use of existing data and samples and relatively simple models over more expensive field data collections and experiments. We also expect to take a staged approach, roughly in the order of the research questions, to maximize learning at each stage and make the succeeding stages as efficient as possible.

The proposed research will comprise 5 broad tasks: 1) *Analysis of existing data* on co-occurrence of fish and their prey, and on the inputs of various sources of organic matter to the estuarine ecosystem; 2) *Modeling* to set up a framework for the analyses and experiments, and to investigate the limits that system productivity places on increases in fish populations; 3) *Fish sample analyses* to increase information on the feeding relationships among the fish and their zooplankton prey and how those have changed since the spate of introductions; 4) *Experiments* on interactions between fish and their prey, and among the various zooplankton species; and 5) *Synthesis* of the overall results into a comprehensive and detailed conceptual model.

Products from this research program will include reports detailing the role of introduced species in the foodweb, the effects of these species on the fish species of interest and the estuarine ecosystem as a whole, and the potential for lifting limits on system productivity or population abundance within the system as it now exists.

The research team submitting this proposal is uniquely suited to carry out the research, and to provide an interpretation relevant to CALFED's goals. The Lead Principal Investigator (PI), Wim Kimmerer, has extensive experience in all aspects of the proposed research in the Bay-Delta estuarine ecosystem and elsewhere. His experience as a member of the Core Team for the ERP Strategic Plan gives him the perspective to ensure that this project is not merely an academic research project, but that it has direct relevance to the ERP. Dr. Steve Bollens is a world-renowned expert on zooplankton and on interactions between fish and zooplankton. Dr. Bill Bennett is well known for his research on various aspects of Bay-Delta fish populations, particularly on environmental and human factors controlling early survival and population abundance.

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Executive Summary:

The Chinese mitten crab (*Eriocheir sinensis* H. Milne Edwards) is a recent arrival to the Bay and Delta ecosystem, and its establishment has generated widespread attention. This catadromous crab has already spread over several hundred square miles throughout the freshwater and estuarine ecosystems of the Bay and Delta (Attachment 1). In countries in which it has established, including much of Europe, the mitten crab is known to have dramatic ecological and economic effects (Panning 1938, Clark 1998). These effects range from erosion and collapse of banks and levees due to the crab's burrowing activities, to interference with commercial fisheries due to net damage and possible predation on and competition with harvested species and other aquatic species. The Chinese mitten crab is known in its native range in Asia to carry a debilitating human parasite, the lung fluke *Paragonimus westermanii*. Much of the ecology and impacts of this crab are largely unknown for the crab in its new range here in the Bay and Delta. As a new arrival in its early stages of invasion, with potentially devastating ecological and economic impacts, the Chinese mitten crab merits immediate research attention.

This research proposal addresses the ecology and impacts of the Chinese mitten crab in the San Francisco Bay-Delta ecosystem. This proposal has four goals: 1) monitor the abundance and distribution of the mitten crab, 2) define habitat preferences and quantify impacts on levees and banks, 3) using field and laboratory methods, evaluate the impacts of the mitten crab on commercially valuable invertebrate species, 4) research the role of the mitten crab in the food web, emphasizing impacts to endangered and commercially valuable species. This project will take a multi-level ecological and economic approach in order to quantitatively assess the ecology and impacts of this species in the Bay-Delta ecosystem.

The primary field site for this proposal is the estuary of the South Bay and its major tributaries (Attachment 2). We will establish five core field sites and fifteen additional field sites along these major tributaries in order to monitor mitten crab seasonal patterns in abundance, distribution and migration, habitat preferences and areas where the threat to bank and levee integrity from crab burrowing activities will be the highest. We will analyze additional data from trawl data collected by the Marine Science Institute (MSI), a non-profit education and research organization that conducts continuous year-round trawls of the South Bay, in order to compare freshwater population dynamics of the mitten crab with dynamics in the Bay.

Field enclosures will be used to examine competitive interactions between mitten crabs and two species of crayfish, *Procambarus clarkii* and *Pacifastacus leniusculus*. *Procambarus* commonly occurs with mitten crabs in the South Bay, and *Pacifastacus* is a valuable commercial crayfish species in the Delta. Surveys of the crayfish and shrimp industries of northern California will be conducted in order to assess catch damage attributable to the mitten crab on these industries. Laboratory experiments conducted at the campus of the University of California at Berkeley will examine the competitive interactions of mitten crabs with crayfish species. We will conduct behavioral experiments at multiple life stages of each species to examine interspecific competition for dominance, food and shelter.

Feeding preference laboratory experiments will be conducted in order to assess the role of the mitten crab in Bay-Delta food webs. Crabs will be presented with food choices including detritus, shrimp, vegetation and aquatic insects. We will introduce the live shrimp *Palaemonetes paludosus* in feeding studies in order to assess whether populations of commercially valuable shrimp such as *Palaemon* and *Crangon*, as well as the endangered freshwater shrimp, *Syncaris*, are impacted by the mitten crab. We will also conduct gut content analysis of crabs collected

from south bay tributaries and Sonoma Creek to look for dietary preferences and determine changes in mitten crab diets with development.

The principal investigator for this project has over 25 years of experience in the field of aquatic ecology (Attachment 3). He will be assisted by a graduate student researcher with significant experience in the field of ecology and natural resource management. The applicants' proposal is supported by several agencies and organizations, including the Santa Clara Valley Water District and MSI. Research efforts will be coordinated with the efforts of MSI and with the research objectives and efforts of members of the Interagency Ecological Project's Chinese mitten crab workgroup, a workgroup in which our laboratory participates.

The proposed research is compatible with several CALFED goals and objectives. In line with CALFED's mission to create a plan to restore the ecological health of the Bay-Delta ecosystem, this research will provide high-quality, quantitative research vital to understanding of the role of the Chinese mitten crab in the health of the Bay-Delta ecosystem. This research will provide the comprehensive monitoring, indicator development and directed research that are called for in pages 6-11 of the Ecosystem Restoration plan (ERP). The ERP, Volume I, states the need for development of a comprehensive monitoring, assessment and research program (CMARP). This proposal creates a comprehensive program that addresses the response of the Bay-Delta ecosystem to disturbance at multiple spatial and temporal scales. The CMARP directive emphasizes the current fragmentary nature of existing monitoring and research and calls for a comprehensive and integrated approach to this research. We have close connections throughout government agencies, non-profit organizations and industries that will allow us to disseminate, communicate, and receive feedback on our project to make this work as integrated with and appropriate to research and management needs as possible.

This proposal meets several strategic objectives defined in the ERP. The proposal addresses the needs identified in the ERP to specifically research the interaction of the Chinese mitten crab with the commercially-valuable signal crayfish and grass shrimp, identified by the ERP as species targeted for maintenance and enhancement. Research will also establish impact of the mitten crab on the California freshwater shrimp, identified by the ERP as a priority species for population recovery and management. This proposal also answers the goals stated in the ERP and detailed in the draft Non-Indigenous Species Management Plan to identify, delineate and understand the mechanisms of impact of invasive species.

As mitten crab populations spread, more and more habitats and species will be affected. Accelerated bank erosion is already visually evident among sloughs in the South Bay (Halat 1996). Government fish facilities are already heavily affected by large numbers of mitten crabs clogging facility intakes (Scott Sigfreid, pers. comm.) The damage from mitten crabs is clearly beginning. The more knowledge we have about the mitten crab, the better prepared we will be to make informed decisions about its management. This proposal presents a unique opportunity to begin early in the process of establishment of this species to quantitatively assess the ecological and economic impacts of the Chinese mitten crab and contribute meaningfully to our knowledge about the health of the Bay-Delta ecosystem.

Executive Summary

Purple loosestrife is a perennial plant from the European Continent which has invaded North America. It has moved extensively throughout the wetlands of the United States causing immense ecological destruction. It is now showing up in California in a number of small, but growing, infestations that are currently not under eradication or containment. It poses an aggressive threat to almost all the wetland and riparian habitats in the CALFED focus area. This threat is of greatest concern in the Sacramento-San Joaquin Delta where there are a number of threatened and declining species due to a multitude of environmental stressors.

The following project presents a general hypothesis, based on historic evidence and anecdotal observations, that purple loosestrife is present in multiple locations in the Sacramento-San Joaquin Delta system, and furthermore, that it can be eradicated by implementing an adaptive management program which addresses each infestation with the most appropriate management technique, as determined by CDFA personnel and outside collaborators. Over a three year period, the Integrated Pest Control Branch of the California Department of Food and Agriculture will carry out a series of tasks which will result in:

- 1) Exhaustive yearly survey of the Sacramento-San Joaquin Delta;
- 2) Local eradication of loosestrife in the Delta and other hydrological units;
- 3) Focused perimeter delimitation and survey of all loosestrife infestations in the CALFED focus area;
- 4) Training of agency personnel, working in and near the Delta, to recognize purple loosestrife and other aquatic nonnative invasive species; and
- 5) Education of the boating, water fowl hunting, and similar public citizenry.

Benefits and Linkage to CALFED: If loosestrife is allowed to invade the CALFED system, all of the following attributes will suffer major negative impacts: fish, threatened and endangered native wetland plants and wildlife, interface between farm land and water, recreation opportunities, productivity and nutrient cycling, water flow and quality.

The actions contained within this proposal are fully compatible with and flow directly from the Draft Strategic Plan for the CALFED Nonnative Invasive Species Program (NISP) and the Strategic Plan for Ecosystem Restoration (ERP StratPlan). The mission of the NISP is to "Prevent establishment of additional non-native species and reduce the negative biological and economic impacts of established non-native species"(pp 6,7,12, NIS StratPlan). The goals of the NISP Strategic Management Plan are:

- (I) *Prevention* of new introductions and establishment;
- (II) *Limiting* the spread and/or establishment; and
- (III) *Reducing* harmful ecological impacts; ecosystem alteration and displacement of native species (p 2, NIS StratPlan).

This project is fully consistent with Goal 5, of the Strategic Plan for Ecosystem Restoration Program (Table 5-1, ERP StratPlan). The ERP objectives identified for this goal include: Halt the introduction of invasive aquatic and terrestrial plants into Central California (Objective 6) (p 6, ERP StratPlan) and develop focused control efforts on those introduced species where control is most feasible and of greatest benefit (Objective 9) (p 6-7, ERP StratPlan).

Fish Mgmt/Hatchery Recommended For Funding

Prop. No.	Project Title	Applicant Organization	Recommended Amt.
99-F102	Health Monitoring of Hatchery & Natural Fall-run Chinook in SJ River	US Fish & Wildlife Service, California - Nevada Health Center	\$37,860
99-F103	Central Valley Steelhead Genetic Evaluation	CA Dept of Fish & Game, WRB	\$70,636
99-F106	Development of a comprehensive Imple. Plan for a Statistically Designed Marking & Recovery	CA Dept of Fish & Game	\$75,951

Health monitoring of Hatchery and Natural Fall-run Chinook Juveniles in the San Joaquin River and Delta, April - June 2000.

Primary Contact:

J. Scott Foott, PhD
U.S. Fish & Wildlife Service
California - Nevada Fish Health Center
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Type of Organization / Tax status:

Federal Government / Tax exempt

Executive Summary

This project would characterize the health and physiological condition of both natural and hatchery juvenile chinook (*Oncorhynchus tshawytscha*) in the San Joaquin River and Delta. Sampling would occur in April - July 1, 2000 and be in conjunction with the Interagency Ecological Program (IEP) bio-sampling program. The requested funds total \$37,860. The California-Nevada Fish Health Center has conducted similar health and physiological monitoring of chinook smolts since 1991 in both the Klamath and Sacramento River basin (attached report summaries).

Project Description

Weekly samples would be collected from a variety of San Joaquin River sites and the Delta (Chipp's Island trawl) in conjunction with the IEP bio-sampling effort. Laboratory tests for selected salmonid pathogens and physiological indicators of energy reserves, immunodefences, and smolt development would be conducted by the California-Nevada Fish Health Center. An individual fish database would be utilized in the study in order to track disease and physiological disfunction to specific stocks, water temperatures of a given location, and sample date. Quarterly and a final report would be produced by the principal investigator as well as oral presentation(s) of the study results.

Location

Fish collections will occur at the California Department of Fish & Game Merced River

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Fish Facility (MRFF), at various Interagency Ecological Program (IEP) beach seining sites on the San Joaquin River between the confluence of the Stanislaus River and Dois Reis Park (ca. river mile 50 - 74), and from Chipp's Island trawls conducted by IEP biologists.

MRFF	Snelling, Merced Co.	One pre-release sampling
SJ River	RM 50 - 74, San Joaquin Co.	Bi-weekly, April - June30
Chipp's	RM 18, Solano/Contra Costa Co.	Bi-weekly, May - June30

Ecological / Biological Objectives

Declining chinook populations in the Central Valley has prompted an intense restoration effort of this valuable resource and a key element of the State's aquatic biodiversity. Health and fitness of juvenile salmon out-migrants ("smolts") are major determinates of their performance and survival. Infectious disease can influence survival due to both direct mortality and reduced physical performance (predator avoidance, saltwater adaptation, etc.). No comprehensive fish pathogen survey has been conducted on San Joaquin River chinook to ascertain the effect of fish disease on this population. Contaminants and elevated water temperature have been identified in the CALFED process as stressors for salmonids in the San Joaquin River and Delta. Both of these stressors would have the potential for immunosuppressive effects. Hatchery - wild fish interaction is a controversial topic in natural resource management. The criteria used to define a quality hatchery fish is being reviewed and debated among hatchery and fish biologists. It will be important to profile the physiological condition of the natural population in order to compare with hatchery fish. Similarly, a comparison of the pathogens present in both populations is needed to either support or refute the charge that hatchery fish spread disease to natural populations.

Linkage

No comprehensive fish pathogen survey or physiological evaluation of juvenile Fall-run chinook in the San Joaquin River and Delta have been reported to date. This project is primarily directed at the topic of fish management / hatchery operations of a CALFED priority species (pg 421, Artificial Fish Propagation), however, it also addresses the following ERP topics (Feb. 1999 revised ERP Vol.1 and 2):

- a) **Water quality** - evaluation of the biological processes governed by stream temperature. (pg64). *Specifically, any correspondence of disease incidence or impaired physiological performance to elevated water temperatures.*
- b) **Water quality** - evaluation of the effects of contaminants on Fall-run chinook juveniles in San Joaquin River and Delta (pg 421). *Specifically, the occurrence of histological lesions in liver and kidney that are reported biomarkers of contaminant exposure.*

9911-10

Executive Summary

In response to the substantial decline of Central Valley steelhead, considerable planning efforts have begun recently to bring about recovery of steelhead and other anadromous fishes of the Central Valley aquatic ecosystem. However, a comprehensive baseline analysis of Central Valley steelhead genetics is lacking in these planning efforts. The National Marine Fisheries Service previously conducted genetic research on Central Valley steelhead populations, as part of a coastwide status review to delineate Evolutionarily Significant Units (ESU's). The broad scope of the study provided information that was useful for this purpose but did not have the resolution necessary to provide meaningful information within ESU's, such as the Central Valley. There is a need for a comprehensive genetic evaluation that will provide essential genetic information on Central Valley steelhead populations. The purpose of this project is to evaluate and describe the genetic and population structure and genetic variation of Central Valley steelhead populations by analyzing mtDNA and microsatellite DNA. A comprehensive genetic evaluation of Central Valley steelhead populations would provide needed information on the phylogenetic relationships among putative native rainbow trout/steelhead, naturally spawning steelhead, and hatchery steelhead. The foremost benefit of this evaluation will be to identify the most appropriate steelhead populations to use as donor stocks for reintroduction of steelhead to stream systems where they have become extirpated. Other benefits would be an assessment of whether hatchery practices are having unintended genetic effects on the natural populations and an elucidation of structure and genetic variation of natural populations. Collection of steelhead/rainbow trout tissue will be made from approximately 20 locations throughout the Sacramento/San Joaquin river system from July 1999 through August 2001. Tissue from 50 to 100 individuals will be collected from each site using standard methods of collection. Microsatellite DNA and mtDNA will be analyzed at the U.S. Geological Survey, Biological Resources Division Lab in Anchorage Alaska using standard techniques, and a final report and oral presentation of results and conclusions will be completed by April 2002. The project will cost \$174,258 with \$70,636 being requested from CALFED funds. The remainder of the funds will be provided as a cost share by the Department of Fish and Game and by CVPIA-AFRP. The Principal Investigators, Dennis McEwan and Dr. Jennifer Nielsen have extensive experience in steelhead biology, restoration, and genetics. This project is compatible with CALFED strategic objectives (*"determine the abundance, distribution, and structure of existing steelhead populations"* - ERPP vol. I), CMARP Draft Plan (*"A genetic evaluation of Central Valley steelhead populations is necessary to determine phylogenetic relationships among putative native rainbow trout, naturally spawning steelhead, and hatchery steelhead that were founded from non-native broodstock"*), and the CALFED 1999 Action Plan, which identifies steelhead as a high priority listed species.

Project Description

Background: There has been a substantial decline in natural spawning populations of Central Valley steelhead, due primarily to loss of spawning and rearing habitat (McEwan and Jackson 1996). Yoshiyama et al. (1996) estimated that more than 82% of steelhead spawning and rearing habitat in the Central Valley has been lost.

The California Fish and Wildlife Plan (CDFG 1965) estimated that there were 40,000 adult steelhead in the Central Valley drainages in the late 1950's. Hallock et al. (1961) estimated the average annual steelhead run size was 20,540 adults in the Sacramento River system above the

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other agency biologists and other knowledgeable people. Criteria for choosing populations to be sampled will be developed and will include: steelhead populations of high interest (because of water operations or specific restoration projects); steelhead populations that could have metapopulation significance; non-anadromous rainbow trout populations that may be derived from remnant steelhead that are isolated above artificial barriers (but below natural barriers) that are self-sustaining and may exhibit adfluvial or potamodromous migratory behaviors.

Task 2. Tissue collection

It is anticipated that tissue will be collected mostly from June through November because high flows of winter and spring will likely make sampling difficult. Tissues will be collected and preserved according to established protocol, and a portion will be archived in the Department's Central Valley Salmonid Tissue Archive in Rancho Cordova.

Phase 2. Data Analysis - September 1999 through September 2001

This phase of the study will begin as soon as the first samples are collected and sent and will proceed concurrent with the data collection phase.

Phase 3. Report Preparation and Presentation of Results - September 2001 through April 2002

A progress report on data collection and any preliminary results from data analysis will be completed by September 30, 2000. A final report and oral presentation of results will be completed by April 30, 2002. The final report will provide conclusions regarding the four objectives of the evaluation, as described in the *Ecological/Biological Benefits* section of this proposal, will include a dendrogram or cladogram depicting phylogenetic relationships, and will include standard measures of genetic variation.

Location and/or Geographic Boundaries of the Project: The location of this evaluation is the entire Central Valley Bay-Delta watershed, as defined by the Ecosystem Restoration Plan (ERP) geographic scope (page 6 of ERPP, vol 1). However, to elucidate fully the phylogenetic relationships of Central Valley rainbow trout/steelhead, reaches that are presently inaccessible to steelhead because of artificial barriers will be sampled. These may include, but are not limited to, headwater reaches of the M.F. American, Feather, Yuba, and Stanislaus rivers and Battle, Clear, Stony, and Putah creeks.

Ecological/Biological Benefits

Ecological/Biological Objectives: A genetic evaluation of Central Valley steelhead populations would provide needed information on the phylogenetic relationships among putative native rainbow trout, naturally spawning steelhead, and hatchery steelhead that were founded from non-native broodstock. This information will be useful in estimating the structure and genetic variation within and among Central Valley steelhead populations.

EXECUTIVE SUMMARY

Project Description: This proposal responds to Section 3.2 of the Proposal Solicitation Package (PSP) to develop an implementation plan for a comprehensive and statistically-sound marking and tagging program for hatchery-produced Central Valley chinook salmon. The proposed project will develop a plan to implement a Constant Fractional Marking (CFM) program that integrates coded-wire tagging/fin marking (CWT) and otolith thermal marking (OTM) to address central salmon management questions regarding the relative contribution of hatchery and natural production to adult populations as represented in fisheries, spawner populations, and at Central Valley salmon hatcheries, and to develop a means to implement selective fisheries. The scope of this project would include not only chinook salmon but also steelhead. Hatchery-produced steelhead are currently identifiable with an adipose-fin clip but more information would be gained by providing an additional mark or tag that would identify the hatchery and/or release group of origin. An integrated CWT/OTM program represents the state-of-the-art approach to addressing stock identification questions in anadromous salmonids, that includes the ability to achieve a level of resolution to monitor weak natural stocks. The goal of the proposed project is to design an implementation program that identifies how these methods can best be applied to address various stock-identification questions with an acceptable level of statistical reliability.

The proposed approach to developing an implementation plan for an integrated CWT/OTM program is to identify the issues, procedures, potential problems, and costs for tagging and marking; tagging and marking logistics; release strategies; recovery of tag and mark information; and management, analysis, and reporting of data. This information will be developed by working with the appropriate managers and staff of the six State and Federal anadromous fish hatcheries, resource assessment personnel responsible for monitoring salmon and steelhead spawner stocks, the California Department of Fish and Game's (DFG) Ocean Salmon Project which monitors the ocean sport and commercial harvest of salmon, the DFG's Central Valley Salmon and Steelhead Harvest and Monitoring Project, and any other pertinent programs identified in this process.

The proposed project will build upon the products of the current CALFED contractor that include model development for statistically evaluating CFM alternatives by mass-marking with CWT's; recommendations for tagging and recovery rates, estimates of the number of fish to tag, sampling and recovery costs, and analytical requirements. The proposed project will also incorporate the results of a CWT mass-marking demonstration project using new technology, to be conducted as part of the current CALFED project in spring 2000.

Actual coordination, collection, compilation, and synthesis of information will occur under the guidance of a Interagency Implementation Project Work Team (IIPWT) that will be formed as one of the first tasks of the proposed project. The IIPWT will include the project participants and collaborators listed on the title page, and will be chaired and coordinated by the DFG.

Subsequent project tasks will include: (i) identification and integration of stakeholder interests and concerns; (ii) conducting interviews and gathering information from hatchery, monitoring, and resource assessment personnel, as described above; (iii) identification of NEPA/CEQA and ESA/CESA compliance requirements for implementation of a CWT/OTM program, and third

party impacts; (iv) and information synthesis and preparation of the draft through final implementation plan, which is the primary deliverable of the proposed project.

Location of Project: The scope of information gathering for development of the implementation plan will include six Central Valley counties (Butte, Fresno, Merced, Sacramento, San Joaquin, and Shasta counties) and Sonoma County.

Primary Biological/Ecological Objectives: The primary biological objective of the proposed project is to develop a plan for determining the relative contribution of hatchery and natural production to adult populations of Central Valley chinook salmon and steelhead. This is an overriding question in Central Valley salmon and water management which, if addressed, would provide the means to answer a large suite of questions relative to tracking the results of restoration and recovery efforts for salmon and steelhead, including CALFED ERPP actions.

Plan development will be consistent with, and occur in cooperation with, the Comprehensive Assessment and Monitoring Program (CAMP), CALFED's Comprehensive Monitoring, Assessment, and Research Program (CMARP), and priorities of the Pacific Fishery Management Council (PFMC).

Cost: \$74,951

Adverse and Third Party Impacts: No adverse impacts will occur as a result of development of an implementation plan for a CWT/OTM program. The plan will confer a third party benefit.

Applicant Qualifications: Mr. Alan Baracco, DFG, will oversee the project. Mr. Baracco has 27 years of experience with the DFG, including the Ocean Salmon Project, inland salmon and steelhead management, and currently as a manager in the DFG's Central Valley Bay-Delta Branch. Extensive experience in both ocean and inland management of salmon and steelhead is represented within the staff of the DFG. This collective experience and expertise includes: hatchery production of chinook salmon and steelhead; coded-wire tagging and recovery; otolith thermal marking and recovery; angler surveying; and spawner stock assessment.

Monitoring and Data Evaluation: Project progress will be monitored by the IIPWT, and reporting to CALFED on project progress and plan development will occur on a quarterly basis. This responsibility will be borne by the DFG.

Local Support and Coordination with Other Programs: Will coordinate with the current CALFED contractor, IEP, CVPIA-CAMP, CMARP, participant agencies, and the PFMC.

Compatibility with CALFED Objectives: The proposed project will provide CALFED the basis for (i) evaluating and revising salmon and steelhead hatchery operations to result in population augmentation without detrimental effects on wild populations (ERPP, Vol. I, pages 522-523); (ii) being able to track restoration of chinook salmon and steelhead (ERPP, Vol. I, pages 220-224 and 229-230); and (iii) tracking whether CALFED targets for population restoration of chinook salmon and steelhead are being reached (ERPP, Vol. II, pages 25-30).

Environmental Education Recommended For Funding

Prop. No.	Project Title	Applicant Organization	Recommended Amt.
99-B158	Sacramento River Discovery Center	Sacramento River Discovery Center	\$38,400
99-G100	Estuary Action Challenge Environmental Education Project	Earth Island Institute/Estuary Action Challenge	\$50,000
99-G103	Water Challenge 2010 Exhibit	US Army Corps of Eng, San Francisco Bay Model Visitor Center	\$50,500
99-G104	The Learning Watershed Project	American River Watershed Institute	\$55,250
99-G106	Traveling Film Festival & Exhibit/McCormack-Williamson Restoration Film	Independent Documentary Group (IDG Films)	\$50,000
99-G107	River Studies Center Exhibits & Programs	San Joaquin River Parkway & Conservation Trust	\$68,415
99-G117	1999/2000 Bay-Delta Education Program	Water Education Foundation	\$32,300
99-G119	Watershed Educational Training	Colusa County Resource Conservaton District	\$13,000

Sacramento River Discovery Center
CALFED PROPOSAL, April, 1999
EXECUTIVE SUMMARY

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Education

This project will provide a model for connecting students to their watershed through meaningful experiences that include content curriculum, extensive on-site activities, and community connections. The Discovery Center is located in Red Bluff and works with schools from Mt Shasta to Sacramento. By developing a populace that understands and appreciates the complexities of river systems, this program will positively impact all biological/ecological components of the river.

The curriculum/content component of the program will be assured by utilizing **Adopt-A-Watershed** as the core curriculum with added strands from other materials, such as groundwater lessons from the Water Education Foundation, Forestry Issues from Project Learning Tree, and water conservation lessons from agencies and the agricultural community. Adopt-A-Watershed (AAW) is an innovative method of teaching science that uses a school's local watershed as a living laboratory for hands-on activities to make science directly relevant to students' lives. It provides educators with the tools to implement an integrated, sequential K-12 program focused on the local environment and emphasizing student service in partnership with the community. The curriculum will be tied to state and county standards in all subject areas assuring that schools are able to continue using a watershed focus to help students reach academic goals.

Adopt-A-Watershed has in-depth integrated processes that will assure on-going assessment of success and modifications as necessary. Additionally, The California Department of Education and the State Education and Environment Roundtable has invited the Sacramento River Discovery Center (SRDC) to participate in a long-term California Student Assessment Project that will determine the effects of environment-based programs on academic achievement. It's critical during this time that we establish the strongest possible base of programs to coincide with this research to best show the value of on-the-ground activities tied to an academic base to best serve the educational needs of our communities. Support from CALFED will build a foundation for establishing a funding base for these kinds of programs within the structure of educational funding. Programmatic funding will assure longevity and the beginning of systematic natural resources education tied to student's regular course of study assuring that future generations have an understanding of and connection to their watersheds.

The on-site component of the program will build a connection to the land and a sense of stewardship for the land and the water as students develop an understanding of the connectedness of systems in nature and people's place in those systems. A **Field Site Coordinator** will assure quality on-site programs and strong community connections. A major role of the Field Site Coordinator will be to implement a site support program to insure an available population to

serve as docents for interpretive programs on site. This could be accomplished through a high school natural resources academy program, a college intern or community service program, or a well-organized community volunteer program. In practice, a combination of programs would provide the most stable, year-round assurance of quality educational activities on site.

Local connections will be assured by the **broad-based local advisory councils** for each partnership. This group will be organized and facilitated by the site coordinator in partnership with local schools, landowners, and communities, and will be specific to each site.

The CALFED proposal being submitted by Adopt-A-Watershed (AAW) will support the Leadership team and site training for this project. The five teams of schools/districts supported by the Sacramento River Discovery Center Proposal will receive training in AAW materials, leadership skills, and field activities to support their schools as they become AAW schools. AAW will modify their follow-up support to include a full staff training for participating schools. This will build wide knowledge of and commitment to the program and use of the materials. It will also assure schoolwide articulation around curriculum standards mandated by the State Department of Education and local counties.

Private landowner partnerships will be facilitated by the site coordinator. Existing partnerships include work with Lindauer River Ranch, Long's Orchards, and Shasta View Farms. Additionally, programs supported in part by CALFED previous funding have allowed the development of partnerships with the Nature Conservancy, Point Reyes Bird Observatory, and Los Robles Native Plants. This proposal will support, in part, the continuation and expansion of these program elements including native grass restoration and monitoring, bird studies in revegetation sites, and work on Nature Conservancy property to insure watershed-wide program consistency.

We are working closely with two additional partners seeking CALFED funding. The Butte Creek Education program works with us to assure consistency and sharing of educational programs and resources in schools from Redding to Chico. The Placer County Resource Conservation District Program will partner with us to introduce their educational partners to our programs and places and allow us to utilize their training programs to enrich our work and strengthen ties throughout the watershed.

Project Description

Estuary Action Challenge (EAC) is an environmental education project, founded in 1992, focusing on the San Francisco Bay Estuary. EAC works with elementary school teachers and students to explore, clean-up and restore creek and bay habitats, reduce urban runoff pollution and address issues of water quality and safe bay food consumption.

EAC programs address the following environmental needs:

- Many of our East Bay Area urban creeks are trashed, smothered with weeds and lack indigenous plant and animal species.
- Toxins from factories, refineries, pesticide runoff and dumping in storm drains are polluting the bay-delta estuary ecosystem.
- Many people fish from the San Francisco Bay. The food caught is contaminated with pollutants that cause cancer and brain damage.

Each year EAC students:

- plant trees and wildflowers along urban creeks,
- organize community creek and bay habitat clean-ups,
- raise tree frogs in classrooms to release back into creek homes,
- design and distribute creative outreach materials to inform school communities about reducing urban runoff pollution,
- express concerns about estuary pollution issues using letter writing campaigns, interviews with politicians and play performances,
- interview people fishing on bay piers about safe bay food consumption and distribute informational flyers in seven different languages,
- demonstrate safe bay fish cooking to families at school-community events and teach safety precautions that reduce health risks.

Location

EAC works with over 75% students of color from low-income, urban elementary schools in Richmond and San Pablo in Contra Costa County and in Oakland and Berkeley in Alameda County. Creek habitats include Wildcat Creek in Richmond and San Pablo, Strawberry Creek and Harwood Creek in Berkeley and Sausal Creek in Oakland. Bay habitats include Arrowhead Marsh in Oakland and Shorebird Park/Crab Cove in Berkeley, at Berkeley Marina.

Biological/Ecological Objectives

- Increase the number of teachers using local bay and creek habitats as educational resources to empower students to help solve bay-delta estuary environmental problems.
- Adopt, clean-up and restore urban creek habitats.
- Increase public awareness of methods to reduce urban runoff pollution to the estuary.
- Increase the number of people aware of bay pollution issues and using safe bay food consumption practices to reduce intake of toxins and improve community health.

Cost

EAC is requesting \$50,000 from CALFED Bay-Delta to expand our programs by sixty per cent. Additionally, \$9,000 will be provided as cost sharing, in-kind contributions.

Adverse And Third Party Impacts

Student's parents and other family members will attend student presentations, help with restoration projects and go on EAC field trips. No adverse impacts result from EAC programs.

Applicant Qualifications

Estuary Action Challenge is the environmental education project of Earth Island Institute, focusing on the San Francisco Bay Estuary. Earth Island is a nonprofit organization supporting a network of environmental projects. EAC was created in 1992 and in the past seven years 250 teachers and 7,500 students have participated in our programs. EAC currently partners with 45 teachers and 1,400 students each school year. With CALFED Bay-Delta funding, we will expand to work with 75 teachers and 2,000 students. EAC curricula, restoration, pollution reduction and community outreach programs have been developed with high input from teacher and student participants and collaborators.

"Our Estuary Action Challenge program was outstanding. My students learned so much about their local environment and were given many opportunities to act as leaders in their communities. I plan to use the entire curriculum next year with my new students." Sonja Ebel, Fourth Grade Teacher, Hawthorne School, Oakland.

Monitoring And Data Evaluation

Teachers and students are surveyed and the information collected used to improve programs. The results of annual interviews show that 80% of EAC teachers continue teaching programs each year after their training. Additionally, each student participant creates a portfolio of work, used to assess understanding of concepts and skills learned. EAC staff evaluate the successful completion of student environmental stewardship projects by assessing the impact of restoration and community outreach activities.

Local Support/Coordination With Other Programs

EAC collaborates with several local agencies to implement restoration, pollution reduction and community outreach activities. Our partners are: the East Bay Municipal Utility District, East Bay Regional Park District and city and county Clean Water Programs. The Lawrence Hall Of Science Family Health Program works with EAC to increase school-wide family involvement in our programs. EAC will work with the Center For Ecoliteracy to bring together environmental education leaders from around the bay, to share effective strategies for addressing watershed issues.

Over 75% of EAC student participants are children of color from low-income, urban schools in West Contra Costa County, Berkeley Unified and Oakland Unified School Districts. EAC has an excellent reputation for delivering high quality, effective programs. There is a great deal of support in local schools for EAC programs and we have a waiting list of teachers.

Compatibility With CALFED Objectives

The EAC project is compatible with the CALFED Strategic Plan objectives in the areas of environmental education, habitat restoration and water quality. It addresses CALFED objectives to restore, protect and manage riparian habitat types (page 151, ERP Volume 1) and to reduce concentrations and loadings of contaminants to levels that do not cause adverse affects on all organisms and ecosystems in the aquatic environment, including affects on human health (page 506, ERP Volume 1).

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APR 16 1999

Executive Summary

- a. **Project Title:** "Water Challenge 2010":
An interactive, hands-on environmental education exhibit

Applicant Name: San Francisco Bay Model Visitor Center,
US Army Corps of Engineers

- b. **Project Description and Primary Biological/Ecological Objectives:**

This proposal seeks additional funding for a traveling environmental education exhibit titled "Water Challenge 2010". This interactive, hands-on exhibit motivates visitors to learn more about the complex issues of the Bay-Delta by providing them with an exciting experience of personally managing Sacramento-San Joaquin Delta water for ecosystem restoration and other beneficial uses. Visitors are challenged to try their hand at apportioning water flowing from a huge tank (representing the total amount of water flowing from the Sierras into the Bay-Delta watershed) into a series of three smaller tanks (representing the water needs of fish and wildlife, cities and industry, agriculture/food production). As they make their water allocation decisions, visitors receive immediate feedback on the consequences of their actions via video monitors built into the exhibit.

The primary biological and ecological objectives of the "Water Challenge 2010" exhibit derive from increasing public awareness, knowledge and appreciation of Bay-Delta natural resources. By demonstrating the effects of Delta water management decisions on fish and wildlife (especially listed species such as anadromous salmonids and delta smelt) as well as on human users, the exhibit will help foster attitudes supportive of both habitat restoration activities and the careful, well-planned use of Bay-Delta natural resources.

- c. **Approach/Tasks/Schedule**

The Water Challenge 2010 exhibit is being developed and implemented in a series of phased activities, some of which will overlap:

Phase I:	Exhibit Design & Engineering	Mar. 1999 thru Sep. 1999
Phase II:	Audio-Visual Software Development	Jul. 1999 thru Nov. 1999
Phase III:	Exhibit Fabrication	Dec. 1999 thru Apr. 2000
Phase IV:	Installation	May 2000
Phase V:	Exhibit Evaluation & Monitoring	May. 2000 thru Dec. 2000
Phase VI:	Software & Engineering Refinements	Jun. 2000 thru Aug. 2000
Phase VII:	Fabrication of Duplicate Exhibits	Sep. 2000 thru Dec. 2000
Phase VII:	Original Exhibit On-Tour	Jan. 2001 thru Jan. 2010

- d. **Justification for Project and Funding by CALFED**

The proposed exhibit facilitates public understanding of the complex issues underlying the CALFED Bay-Delta Program's mission to develop a long-term comprehensive plan that will restore the ecological health and improve water management for beneficial uses of the Bay-Delta system. The exhibit will appeal to all age groups, in rural as well as urban populations, helping to develop an informed citizenry that both appreciates Bay-Delta natural resources and supports their conservation and wise use.

E. Budget Costs and Third Party Impacts

Phases I and II of the exhibit have been funded by CALFED with a 1998 ERPP grant (98-H1018). We are now seeking \$50,500 in 1999 CALFED ERPP funding to cover the costs of Phase III (Exhibit Fabrication) and Phase IV (Installation). The US Army Corps of Engineers has committed to funding the Phase V (Evaluation & Monitoring) and the Phase VI (Engineering & Software Refinement) portions of the project. Other agencies and organizations have indicated interest in funding and/or installing duplicate versions of the exhibit.

There are no known adverse third-party impacts from the activities for which we are requesting funding.

F. Applicant Qualifications

The San Francisco Bay Model Visitor Center and the US Army Corps of Engineers have extensive experience with the design, implementation and maintenance of exhibit-based environmental education projects.

G. Monitoring and Data Evaluation

Although direct ecological and biological monitoring is not applicable in this case, the project does include mechanisms for measuring results. These exhibit performance and visitor monitoring components include quantitative studies (e.g.--How many people begin and finish the exhibit activity? What proportion of visitors to a venue choose to interact with the exhibit?) and qualitative evaluation (e.g.--Selected visitors will be pre-interviewed and post-interviewed to assess how their knowledge and attitudes about Bay-Delta natural resources and the CALFED mission have been affected by their interaction with the exhibit.)

H. Local Support/Coordination with other Programs/Compatibility with CALFED objectives

The content and video feedback messages of the exhibit are being developed with input and advice from leading representatives of the three main interest groups (agricultural, urban and environmental) who have a stake in the management of Bay-Delta natural resources. A number of agencies and Organizations concerned with environmental and water issues in the Bay-Delta have expressed support for the project, as well as interest in acquiring and installing duplicate versions of the exhibit.

The exhibit is designed to add an exciting, hands-on component to existing educational programs about natural resource conservation, in general, and the ecological problems in the San Francisco Bay/Sacramento-San Joaquin River Delta in particular. In its initial installation at the Bay Model Visitor Center, the exhibit will be coordinated with educational programs and displays on the Bay-Delta ecosystem, the CALFED program, and human impacts on the Sacramento-San Joaquin River Delta ecosystem. When the exhibit travels (California State Fair, other visitor centers, etc.) and when duplicates of the exhibit are installed at other venues, implementation will be closely coordinated with local groups and their existing environmental education programs.

With its ability to help develop an informed citizenry with positive attitudes about Bay-Delta natural resource conservation, the exhibit directly or indirectly supports all of the CALFED Ecosystem Restoration objectives.

9967-104

99 G-104

Executive Summary: The Learning Watershed Project

The Learning Watershed Project is a comprehensive, lifelong learning project with a focus on watershed and the community that is being supported, coordinated, and initiated by the American River Watershed Institute. The project seeks to spawn a multi-age, multi-stakeholder education program that is grounded in the watershed at multiple sites, and integrates the research, educational, governmental, activist and business communities in new ways that are being made possible by the innovative work of the watershed group. The American River Watershed Institute (ARWI) is a new, educational nonprofit created by the American River Watershed Group.

The American River Watershed Group (ARWG) is being successful in bringing together the many stakeholders of the American River Basin. ARWG sought and received Proposition 204 funding to undertake an extensive fuel reduction and water quality project involving the many local, state, and federal entities with the community and the private sector. Acknowledging the need for a Coordinated Resource Management Plan, ARWG sought and received Category III funding to initiate a CRMP on the North and Middle Forks of the American River, and is currently seeking to coordinate with stakeholders on the South Fork to integrate planning efforts for the entire Basin. These multi-stakeholder project management and planning efforts are being successful because they can address the complex, multi-faceted problems and needs of the watershed in ways that single entities with narrow focus cannot.

A similar need exists for watershed education. Educational approaches to watershed have been compartmental. Some excellent curricula have been developed for certain grade levels. Some adopt-a-stream or watershed programs have been developed, and are being implemented on some streams by certain grade levels. Some very good nonprofit organizations are developing extensive programs that address selected client bases. But programs are rarely knit together, and very large gaps exist. One such gap was recognized by ARWG; among their many stakeholders, there was no entity appropriate to steward the expansive educational programs that are implied and required by integrated watershed planning, research, and project management. It was for this reason that ARWG (an MOU collaborative with no legal standing that functions through delegation to its members) created ARWI (a private, incorporated nonprofit). The mission of ARWI is to support the educational and research work of the ARWG CRMP. The Learning Watershed Project Category III grant submittal includes six components (6 tasks) to address these needs:

- 1) Initiation of a summer institute with its first site at French Meadows Learning Watershed Center on the Middle Fork of the American River. This two-year program will catalyze an ongoing program for teachers and students in research and restoration projects from start to finish that have been initiated by the ARWG. Category III funds (\$20,150) will allow an educational element to be added to a research element that has already received State Water Resource Control Board funding.
- 2) Establish and nurture a teacher core at the emerging Todd Valley Miwok/Maidu Cultural Foundation (TVMMCF) on the Foresthill Divide to complement the Learning Watershed network. Category III funds (\$13,000) will over two years train the Miwok/Maidu trainer core so that Native American Heritage and knowledge of its ecological cultural practices can be integrated into ARWI's ongoing Learning Watershed Project. The training will promote inclusion of the Cultural Foundation Center as a node for ecological learning within the watershed.
- 3) Enhance watershed learning at the Placer Nature Center (PNC) through development of exhibits within the Community Watershed Education building. Established in 1991, PNC offers thematic environmental education programs designed to promote an understanding and awareness of

the natural environment, cultivate scientific literacy and stimulate stewardship attitudes toward the earth. Over 6,000 school children in grades pre-school through 12 visit the Center annually. The Education Water Shed will introduce students and teachers to the basic concepts of watershed – with interactive activities that demonstrate these concepts. It will serve as a “first stop” in a progressive watershed learning program; culminating in students and teachers becoming watershed educators and activists within their own communities. Two exhibits within the Education Water Shed will be funded with this grant – Water and nature and Water and People (\$15,400). Placer County Water Agency, Placer County Parks Department, US Bureau of Reclamation are providing matching funds for the Water Shed building development, an American River three-dimensional model and exhibits.

- 4) Integrate Upper and Lower American River Watershed educational programs. Currently, a well-funded watershed education project, SPLASH, has been initiated in Sacramento County. One of the constraints of the project is that funds may not be spent outside Sacramento County. Category III funds (\$4,200) will support a design charrette at the French Meadows Learning Watershed Centers where, after a tour of the major upper watershed learning sites (including PNC, TVMMCF and USFS/BLM sites) the Sacramento County and Placer/Eldorado County watershed stakeholders can co-design a watershed learning program network that can serve the entire Basin from Pacific Crest to confluence with the Sacramento River.
- 5) Watershed learning networks are mushrooming at various levels of development throughout the Sacramento River Watershed. The networks are not in communication with one another, nor are the enterprising founders and participants aware of the program successes and failures of other emerging networks. A coordinating and planning session of the Sacramento Watershed learning networks would reduce duplication of effort, needless competition for resources, and inefficiencies. AMRI in partnership with the Red Bluff Sacramento River Discovery Center propose a focused convening of these learning networks in March 2000 in Red Bluff. Category III funds (\$3,000) will enable a poster session, program inventory and assessment, a collaboratively designed plan for coordinated implementation, a cooperative plan for website linkages, a mutual marketing plan for programs, and collaborative grant submittal plan for these emerging watershed learning networks.
- 6) The final element of Category III fund request (\$2500) is for task management and grant oversight and reporting. All of the elements of this request are consistent with the CALFED Ecosystem Restoration Projects and Programs Environmental Education eligibility standards (Feb 99) and the Revised Draft Watershed Program Plan (Feb 1999). The Learning Watershed Project is community based, consistent with CALFED, addresses multiple watershed issues, is coordinated with and supported at multiple levels, provides for ongoing program, includes monitoring protocols, and increases learning and awareness. In particular, the proposal reflects a very high level of coordination with existing educational resources and with watershed stewardship groups.

The principle applicant, the American River Watershed Institute, on behalf of the American River Watershed Group, and the partners, Placer Nature Center, SPLASH, Todd Valley Miwok/Maidu Cultural Foundation, and Sacramento River Discovery Center, are in leadership roles in watershed education in the State or in their communities. All the partner applicants work closely with local, regional, state, and federal levels of government, as well as the community and business sectors. The project should have minimal adverse or third party impacts; full NEPA compliance is built into the project where appropriate. The total amount requested in this Category III proposal is \$58,250

**Proposal to Category III
Environmental Education**

Executive Summary

Project Title

Title: 1. Bay/Delta Traveling Film Festival & Exhibit
2. McCormack-Williamson Restoration Film

Applicant: Independent Documentary Group (IDG), in cooperation with the Nature Conservancy, UC Davis, Center for Integrated Watershed Science, Save the Bay, Greenbelt Alliance, San Francisco Bay Bird Observatory, Estuary Action Challenge, and numerous other nonprofits/libraries/schools

Contact: Ms. Judy Irving, 415-824-5822

Project Description and Primary Biological/Ecological Objectives:

1) Expand the impact and reach of IDG's CALFED-funded Traveling Film Festival (utilizing IDG's Emmy-Award-winning films about Bay/Delta habitats and wildlife), by booking additional screenings in the Bay Area and east into the Sacramento Valley; 2) Shoot and edit the first three years of a long-term project documenting the restoration of the McCormack-Williamson tract in the Delta.

1) IDG is now distributing, with funding from CALFED, a six-film Traveling Festival & Exhibit, which premiered in March 1999 at San Francisco's Civic Center Library and which showcases over \$500,000 worth of IDG films about the Bay and Delta: *Secrets of the Bay*, *Treasures of the Greenbelt*, *San Pablo Baylands*, *Heron Island*, *Kids by the Bay*, and *Partners on the Land*. The films are accompanied by a variety of expert speakers who bring up-to-the-minute information about on-going restoration activities and encourage audiences to become locally involved. The series appeals to a general audience (adults and children), and has garnered rave reviews. Following its initial screenings in the nine-county Bay Area in 1999, IDG proposes to expand the series in the Bay Area and take it to Sacramento and other locales in the Valley and North Delta, where it could have an even greater impact.

2) Working closely with Mike Eaton of the Nature Conservancy, IDG will film baseline sequences at the McCormack-Williamson tract in the lower Cosumnes watershed, a 1654-acre island surrounded by approximately 8.8 miles of levee. Early footage will focus on current uses of the island (farming) and preparation for restoration of one of the rarest ecosystems: tidal freshwater wetlands. Wildlife-friendly levee maintenance, environmentally compatible farming operations, and long-term restoration of the island will eventually be included in the film, which

will show general audiences what restoration looks like over time. Interim versions of the film will be edited at the end of each year of the initial three-year period.

It is essential to inform the public about restoration activities and results; public support for the CALFED effort is critical. This is particularly crucial in the initial stages of implementation, when the public, and the restoration community, will have many questions about CALFED's approach and activities. The Film Festival and restoration movie further CALFED's goals by providing information in a medium the public enjoys and understands, by galvanizing public opinion, and by encouraging public participation.

Costs and Third Party Impacts

IDG proposes a total budget of \$339,150: \$71,150 for a one-year extension of the Traveling Film Festival; and \$268,000 for the McCormack-Williamson restoration film for three years of filming and editing. There are no third party impacts.

Applicant Qualifications

IDG is an Emmy-Award-winning firm, well known for 20 years for its environmental work (*Secrets of the Bay, Treasures of the Greenbelt, San Pablo Baylands, Dark Circle*). IDG's recent Delta film, *Partners on the Land*, describes natural process restoration at the Nature Conservancy's Cosumnes River Preserve and was produced in collaboration with Mike Eaton, Preserve Manager. Previous sponsors of IDG films include Save San Francisco Bay Association, the Greenbelt Alliance, Audubon Society, EPA, Metropolitan Water District of Southern California, National Endowment for the Arts, private foundations, and individuals.

Monitoring

Bookings, attendance figures, and audience response will serve as monitors of the Traveling Film Festival's and restoration film's effectiveness.

Local Support/Coordination with Other Programs/Compatibility with CALFED Objectives

Based on current bookings of the Traveling Film Festival, many groups and venues will work with IDG as the project expands: libraries, schools, colleges, museums, land trusts, environmental fairs, Earth Day events, and others. (see *Linkages*.)

IDG's long-term commitment to the Bay and Delta mirrors CALFED restoration objectives: In its films is the power to entertain, educate, shape public opinion, and inspire action.

**River Studies Center Exhibits and Programs
San Joaquin River Parkway and Conservation Trust
CALFED Bay-Delta Program Environmental Education Grant Request**

Executive Summary

The San Joaquin River Parkway and Conservation Trust (River Parkway Trust) is requesting \$110,895.00 to develop environmental education program exhibits for Riverview Ranch. The historic 1890 ranch, located on the San Joaquin River, is now being restored and is planned to open as The Coke Hallowell Center for River Studies in June, 2000.

The exhibits and programs produced by this project will examine the natural resource issues of the San Joaquin River mainstem from its headwaters to the San Francisco Bay. The historic ranch provides an excellent setting to provide education programs that place a focus on the importance of the River's ecological health.

Approval of this grant request will result in:

- developing exhibits, videos, and environmental education programs focused on increasing public knowledge of San Joaquin River resource issues
- fostering the goals of the CALFED Bay-Delta program with a particular focus on the San Joaquin River Ecological Zone (ERP, Vol II., pages 371-395)
- timely delivery of an education program through an existing successful public service provider
- leveraging local collaborative efforts and private funds

The mission of the River Parkway Trust is "to preserve and restore San Joaquin River lands having ecological, scenic, historic, or agricultural significance, to educate the public on the need for stewardship, to research issues affecting the river and to promote educational and recreational use consistent with the protection of the river's resources."

Founded in 1988, the River Parkway Trust, a non-profit land trust, has completed many major projects including land acquisition, riparian restoration, and multi-use trails. The River Parkway Trust's river education program is utilized by approximately 10,000 children and adults in the Fresno-Madera Region each year. Riverview Ranch is part of the San Joaquin River Parkway and is identified as an interpretive center site in the San Joaquin River Parkway Master Plan and EIR, adopted by the San Joaquin River Conservancy of the California Resources Agency.

Environmental Education Grant, River Studies Center
San Joaquin River Parkway and Conservation Trust, CALFED Bay-Delta Application

The Water Education Foundation's 1999/2000 Bay-Delta Education Program consists of separate but complimentary projects that together would exponentially increase the public's awareness and understanding of the issues affecting the Bay-Delta, and make it feasible for members of the public to support CALFED while altering their behavior to be a part of environmental solutions.

► **Briefing Paper on Wetlands and Marshes**

The Water Education Foundation has provided up-to-date and usable information through the use of Layperson's Guides, *Western Water* magazine, and other publications for more than 20 years. The Foundation has provided information on water issues in general with the 15 Layperson's Guides by covering such important topics as California Water, the Delta, Water Pollution, and Water Conservation, and two recent issues of the bi-monthly *Western Water* covered developments of CALFED. The Briefing Paper on Wetlands and Marshes would be a timely reference tool to add to these publications, educating the public about CALFED's objective to restore and protect wetlands and marshes.

This publication would include the history of wetlands conversion, how we came to realize that wetlands and marshes serve important water quality and flood management functions, and the importance of the habitat for numerous resident and migratory waterfowl, and many species of fish, plants, invertebrates, amphibians, reptiles, and mammals. The Briefing Paper on Wetlands and Marshes would highlight the benefits and values of wetlands in California, with a special focus on the Delta. Attention will be paid to the costs and benefits of wetlands restoration and options for mitigating historic reclamation. In addition, the publication will discuss the causes of decline of the health of wetlands, making the connection between this valuable resource and how our society is choosing to manage open space and water resources, discuss the controversies, and show the critical importance of non-native plant and animals. 3,000 Briefings will be printed, and major portions of this publication will be added to the Foundation's web site which receives at least 3,000 visits per month, and the Foundation is committed to revising this electronic document as is necessary. The distribution of this publication and visits to the document on the internet will be monitored.

► **Water Minute Radio Broadcasts**

In addition to the written media, radio has the potential to increase the public's understanding and appreciation of water resources by repeatedly making connections between water issues and the daily routines of Californians. This is a low cost tool to reach millions of people. The Foundation proposes to develop a series of 30 and 60 second radio broadcasts that would address such topics as water conservation, nonpoint source pollution, environmental restoration, and invasive species - all of which support CALFED's objectives. By repeatedly airing the "water minutes," we can introduce listeners to these important subjects, while bringing their attention to where their water comes from, how it is made available to them, and the resource choices facing them. Successful models include the "Stargazer" radio programs and the U.S. Census Bureau's campaigns, both which have greatly heightened the visibility of the issues they promote.

This series of professional-quality programs will consist of 15 components. They will air on several stations within four key regions within the Geographic Scope of the CALFED Bay-Delta Program during the spring months of 2000: Fresno, Redding, Sacramento, and the San Francisco Bay Area. As an additional program component, they will be broadcast in the San Diego and Los Angeles areas if you believe, as the Foundation does, that residents in southern California must understand Bay-Delta issues also. Stations selected to air the programs will be chosen to ensure a diversity of listeners, and will include a mix of news, talk, and music stations. Air time will be solicited as donations, but much air time will need to be purchased as the Federal Communication Commission (FCC) no longer requires that stations donate time for community service announcements.

946-711

Hydroexplorer: A California Waterways Adventure

The Water Education Foundation proposes to update one of its valuable education tools, the "Hydroexplorer: A California Waterways Adventure" computer game. The Foundation is at the forefront of children's education on water resources and one of the most valuable tools has been a series of Hydroexplorer computer games. The most relevant game to the Bay-Delta system is Hydroexplorer: a California Waterway Adventure, which allows players to guide a submarine through the watersheds of the Sacramento, Feather, and San Joaquin rivers. This game teaches players about the geography of these waterways, the dynamics of a watershed, and water allocation. These concepts are the basis for understanding the current difficulties and measures being taken to restore the Bay-Delta. The game is distributed with a teacher's manual packed with interdisciplinary lesson plans that satisfy California's teaching requirements.

Since the Hydroexplorer game was originally produced, technology has improved in ways that makes the game difficult to use (please see the attached letter by Kim Epperson). Elementary schools are currently very interested in using computers in their classrooms, so the Foundation proposes to revise and update the game to be compatible with the most current version of Windows (for Macintosh and IBM-compatible computers). In addition, a section specifically on the Bay-Delta will be added which will teach about topics including wetlands, the salmon life cycle, and water quality and drinking water, all of which support CALFED goals and objectives. Sections of the game will be posted on the Foundation's web site which receives at least 3,000 visitors each month, many of which are children looking for ways to learn about water issues. 500 copies of this updated game will be distributed free to educators through a variety of avenues, including Foundation workshops, conferences, and water district sponsored education programs that partner with the Foundation.

Journalists Tour of the Bay-Delta

The Foundation received CALFED funding in 1998 to host a tour for journalists relating to the Bay-Delta. By educating the media, this project will ensure that Bay-Delta issues maintain a high visibility in the press, and that accurate and up-to-date information is relayed to the public. The response to this free tour, scheduled for May 8, 1999, has been strong and indicates a need for additional services. The Foundation proposes to host another tour in 2000 that will keep the 1999 tour attendees continually informed, but also to educate reporters that may be unable to attend this year's tour. Issues to be discussed during the 1999 tour agenda include the balance of water uses, dependent fish species, and Delta agriculture. This project supports CALFED's goal to increase the public's understanding of resource issues, and through this education, encourage thoughtful water use and resource care.

Update "Setting a Course: the California Bay-Delta"

The Foundation produced a high quality and well distributed public television documentary on the Bay-Delta. This program satisfied a dire need for public understanding of CALFED and the importance of the Bay-Delta. This documentary, narrated by actor Timothy Busfield, explained issues such as historic water allocation, dependent species, and water quality concerns. In the May 1998 proposal to CALFED, the Foundation requested funding to update the documentary. It was recommended that the Foundation solicit general funds from CALFED. Funding was solicited in this fashion and there has been no response. Even so, the Foundation revised the documentary after the release of the December 1998 draft report, and will be releasing this new program to the PBS satellite system on April 18th, 1999. The Foundation subsequently made all of this revised footage available to CALFED for the creation of a summary video produced in January 1999. Given the vital need to keep the public informed of CALFED's progress in these ways, we ask that you seriously consider allocating funding to update the documentary once the revised draft programmatic EIS/EIR is released in 2000, allowing the PBS/CALFED partnership to continue into 2000.

Executive Summary:

The purpose of the Colusa County Resource Conservation District's (CCRCD) Watershed Educational Training (WET) project is to increase watershed awareness through environmental education in Colusa County. Before the public as a whole can fully support CALFED's objectives, they must first understand the need for watershed restorations so vital to the ecosystem. The public must be able to identify how their own watersheds fit into the "Big Picture" when it comes to ecosystem health. The WET project will do this by linking our community watershed health with the ecological objectives and goals identified by CALFED. The WET project will supply the knowledge that enables the public to make sound environmental decisions that come with appreciation for our natural resources. The WET project will educate our youth, who will be the environmental stewards of tomorrow. WET will also educate farmers, ranchers and outdoor enthusiasts, whose actions today can effect the ecosystem for hundreds of years.

The WET project evolves around the use of EnviroScape interactive watershed models to demonstrate nonpoint source water pollution and wetland and riparian benefits to the ecosystem. The WET Project Manager/Educational Coordinator will create and implement three watershed presentations. The ecological processes of Central Valley streamflows, natural sediment supply, stream meander, floodplains, upper watershed process, wildlife and fishery habitat will be addressed. The demonstrations will be presented at the Colusa County Farm Show, the Colusa County Farm Day, and 5th grade classrooms throughout the county. The CCRCD has past experience working with these groups and has a long term commitment to Conservation Education. Upon completion Teachers will be given evaluation forms used to critique the effectiveness of the presentation. Educational outreach will be monitored by attendance records from events. The WET project has the collective support of the Colusa County Office of Education, Colusa Basin Drainage District, Family Water Alliance and the Natural Resources Conservation Service.

Total expense for the WET project is \$20,686.00 the CCRCD is requesting \$13,000 from CALFED. This project has no apparent negative third party impacts.

Project Description:

Proposed Scope of Work: The Colusa County Resource Conservation District (CCRCD) is the lead agency for the WET project. CCRCD has an MOU with the USDA and with the Natural Resources Conservation Service (NRCS). Via the MOU's the NRCS will supply technical expertise in the development of all educational presentations.

The WET project revolves around the use of EnviroScape interactive watershed models to teach the importance of how the public's actions can have both positive and adverse effects on the watershed ecosystem. The educational outlets specified below have proven track records of attendance, which allows the WET project exposure to large audiences without a substantial financial investment. Outreach also includes the hard to reach public that traditionally does not attend tours and seminars.

Task I; The WET project will provide for the purchase of EnviroScape interactive watershed models and material. The Project Manager/Educational Administrator will develop three presentations on the following topics; Nonpoint Source Water Pollution, Wetland Benefits and Riparian Benefits using the EnviroScape watershed models and curriculum. The presentations will link our community watershed health with the ecological objectives and goals identified by CALFED. The presentations will be designed to increase public awareness, knowledge and appreciation of natural resources and ecosystem restoration activities.

The Nonpoint Source Model will be used to demonstrate how water pollution comes from many sources. Nonpoint sources contribute a great deal to the pollution in our water bodies. The WET project will teach

Ecological/Biological Benefits:

Ecological/Biological Objectives: The Ecological and Biological benefits of this project are both short and long term. The immediate primary benefit of this project is an educated public that will be able to make informed decisions critical to the success of CALFED and the CCRCD vision for a healthy watershed. The WET project will also prove to be a long term benefit as well, as it is designed to increase the understanding of a watershed's important role in the ecosystem and how today's actions effect conditions down stream and watershed health long into the future. The long-term ecological health of the Delta depends on the health of its component parts. The Colusa Basin Ecological Management Zone contribution to the health of the Sacramento-San Joaquin Delta and Sacramento River Ecological Management Zones will increase after its ecological processes, habitats, and ability to support sustainable fish, wildlife, and plant communities are improved. Improvements can only come about through actions by an informed public. Education will reduce human activities that adversely affect wildlife behavior or cause habitat destruction, decrease reproductive success, and contribute to the decline of important species.

Linkages: Education of the Community to become knowledgeable and involved with the ongoing efforts in the watersheds they live in. The Colusa Basin Ecological Management Zone is directly linked to the Sacramento River through the Colusa Basin Drain and its sub watersheds. This Ecological Management Zone provides important habitats for a variety of migratory species including anadromous fish, waterfowl, and other species dependent on wetland and riparian habitats. The Colusa National Wildlife Refuge has some of the highest concentrations of giant garter snakes in the Central Valley. Watershed models will be made available to the Sand and Salt Creek Watershed Project (CALFED 1998 Funding) to be used at Public Meetings and Tours to demonstrate riparian buffers, cover crop, and nonpoint source water pollutants. The CCRCD will seek additional funding to continue to utilize the watershed models, for watershed education, after the CALFED grant has ended. The models will be used for AG-In-The-Classroom presentations to expose additional teachers to watershed training tools available to their students.

System-Wide Ecosystem Benefits: The WET project supports educational public outreach on how our community watershed health benefits the ecosystem as a whole. Each management zone is interdependent of the next creating a mosaic of habitats vital to the ecosystem. Public awareness of these ecosystem relationships will increase public support of system-wide restoration projects now and in the future.

Compatibility with Non-Ecosystem Objectives: None of the CALFED objectives or goals can be met without the environmental education element. Ecological restoration efforts require human intervention.

Technical Feasibility and Timing:

WET is a technically feasible and ready to go project. Educational materials will be ordered upon securing a fully executed agreement between CALFED and the CCRCD. The WET project will utilize existing successful interactive educational models, curriculums and the expertise of supporting agencies.

Executive Summary - Directed Action for Flood Control Bypass Habitat Program

II. Executive Summary

A. Project Description

99B-189
panel C

The Yolo Basin Foundation (Foundation), an established organization of local stakeholders with strong ties to and interest in the Yolo Bypass (Bypass), proposes, along with Natural Heritage Institute (NHI) and DWR, to conduct the baseline monitoring, alternatives development and analysis, and design necessary to "expand and enhance seasonal shallow-water habitat in the . . . Yolo Bypass," a key opportunity identified in the CALFED Strategic Plan for Ecosystem Restoration (Strategic Plan) (p. 41).

This project will build on the technical studies and stakeholder process currently being conducted as part of the Foundation's Ecosystem Restoration Strategy for the Bypass project that was funded by CALFED last year (project begins in May 1999). Recent studies suggest that inundation of the Yolo Bypass during wet years has substantial benefits to many native fish species and other organisms of the estuary, including Sacramento splittail (*Pogonichthys macrolepidotus*) and juvenile salmon.

The project applicants will identify, design, and implement the optimal combination of management and infrastructure modifications necessary to seasonally inundate a small portion of the Bypass (5,000 acres) for fish and wildlife during dryer years without impacting water supply for existing water rights holders or compromising existing uses of the Bypass. The project will be carefully designed and implemented as an experimental pilot project intended to inform future restoration actions according to the adaptive management model.

B. Location

The proposed project is located in Yolo County, California (Figure 1). The project will most likely be located along the eastern edge of the Bypass where elevations are lower. The selection of a specific site will depend on the input of stakeholders in the Bypass, including landowners, who will be involved in project analysis and design.

C. Primary Biological/Ecological Objectives

- Expand and improve spawning conditions for Sacramento splittail
- Improve rearing conditions for juvenile salmonids
- Enhance Delta food web productivity
- Reduce stranding and improve passage of native fish
- Enhance spring staging habitat for shorebirds

D. Cost and Schedule

This project will be implemented in the following three phases in conjunction with the Ecosystem Restoration Strategy. **This proposal seeks funding for Phase I only.**

• Phase I: Baseline monitoring, alternatives analysis, and design	1/2000	1/2001	\$820,679
• Phase II: Environmental compliance and permitting	1/2001	6/2001	\$150,000
• Phase III: Construction and operation	6/2001	11/2001	\$4,000,000

E. Adverse and Third-Party Impacts

The project will be carefully designed with local stakeholders, landowners, and responsible agencies to avoid any third-party impacts. In particular, the project applicants will coordinate with flood management agencies, water suppliers, and local landowners to ensure that the project does not reduce flood protection, impair water quality, or infringe on agricultural use or private property rights.

F. Applicant Qualifications

The project will be jointly managed by a special private/public partnership comprised of the Foundation, DWR, and NHI. These three entities will serve as the Management Committee. All decisions regarding project scope, budget, deliverables, and implementation of this project will be made by consensus.

The Foundation will represent local stakeholders throughout project design. The Foundation has established credibility within the Bypass community and among the many stakeholders that will help build a consensus design. As project manager of the Ecosystem Restoration Strategy, Foundation's participation provides the key link needed to successfully move from strategy to implementation as envisioned in this proposal.

NHI will serve as the fiscal agent and administrator of the project under the direction of the Management Committee. NHI will participate substantively by identifying biological constraints, developing project design, analyzing legal and institutional constraints posed by land and water rights and regulatory and permitting requirements, and coordinating statewide outreach to CALFED stakeholders.

DWR will lead project monitoring studies and assist in project evaluation and design.

The project team will include facilitators, planners, and scientists from Jones & Stokes Associates. Engineering design and analysis will be done by engineers with Northwest Hydraulic Consultants (NHC). Both organizations have expertise in hydrology and restoration planning in the Bypass.

G. Monitoring and Data Evaluation

The project will be specifically designed to test multiple hypothesis regarding optimal conditions for each of the species, guilds, and processes referenced in the goal statements. DWR staff, in conjunction with the project team and independent and agency scientists, will develop a monitoring study design that will be peer reviewed according to Interagency Ecological Program (IEP) standards. A key part of this phase of the project will be initiation of a preproject monitoring program designed to produce data suitable for agency reports and peer-reviewed scientific journals. Details on the sampling, preservation, and analytical techniques will follow the Yolo Basin Study Plan already developed for IEP.

H. Local Support and Coordination with Other Program

Numerous stakeholders and agencies have interests or jurisdiction in the Bypass. Conducting public outreach to public stakeholders and coordinating with relevant agencies are the required first steps of this project. The public outreach element will be integrated into the Ecosystem Restoration Strategy process. Members of the Yolo Basin Working Group (Working Group) created for that project will be invited to attend bimonthly meetings to refine project goals and objectives, identify opportunities and constraints, evaluate alternative designs, and develop measures for implementing the project goals and objectives. Two technical and informational workshops will be conducted concurrently with the Working Group meetings. Workshop participants will include, but not be limited to, the Working Group, CALFED staff, elected officials, natural resource agencies, natural resource conservancies, academic representatives, agricultural and water user industry representatives, and landowners. These workshops will be in addition to those already identified under the Ecosystem Restoration Strategy and will focus specifically on the details of this pilot project.

I. Compatibility with CALFED Objectives

The Bypass project is consistent with CALFED's ERP objectives.

Nonnative Invasive Species Directed Actions

Proj. #	Project Title	Applicant/Organization	Amt Requested
99-DA14	Nonnative Invasive Species Advisory Council	Fish and Wildlife Service	50,000
99-DA15	Reducing the Risk of Importation and distribution of non-native Invasive Species through Outreach and Education	UC Davis	105,466
99-DA16	Zebra Mussel Detection and Outreach Program	DWR	100,000
99-DA17	Purple Loosestrife Prevention, Detection and Control in the Sacramento and San Joaquin Delta and Associated Hydrologic Units	CA Dept of Food and Ag	201,306
99-DA18	Introduced Spartina Eradication Project	CA Coastal Conservancy	250,000
99-DA19	Practical Guidebook to Prevent and Control for Nonnative Invasive Plants in Shallow Water Habitats of the Bay-Delta Ecosystem	SFEI	76,750
99-DA20	Effects of Introduced Clams on the Food Supply of Bay-Delta Fishes	San Francisco State	100,490
		Total	778,546

Executive Summary

As described in the Strategic Plan for Ecosystem Restoration and the ERPP Vol I and II, nonnative invasive species (NIS) are major stressors in all habitat areas of CALFED concern. The impacts of NIS vary so widely as to effect nearly every topic area discussed in the CALFED documents. The ERP Strategic Plan contains six major goals of the CALFED Program. Goal 5 reads "Prevent establishment of additional nonnative species and reduce the negative biological and economic impacts of established nonnative species". This goal consists of ten Objectives which can be found on page 5 of Table 4-1. California's natural and man made water conveyance and impoundment systems are available and utilized for multiple purposes. In addition, there is a complex mosaic of federal, state and local laws and regulations which not only address intended use of these resources but will impact efforts to prevent the introduction, establishment and management of NIS.

In September 1998, CALFED provided \$1.25 million to the U.S. Fish and Wildlife Service to develop NIS work teams, draft NIS Strategic and Implementation Plans and fund projects to address NIS issues of concern. The NIS work teams have been working on this program since October 1998. The draft Strategic Plan has been submitted to CALFED staff for approval and public review. The draft Implementation Plan is in final work team review. Directed projects have been developed to begin work on priority issues, as identified in the NIS documents and the Strategic Plan for Ecosystem Restoration. The NIS teams have also provided technical review of proposed CALFED NIS projects for the 1999 PSP. The development of this program has led to the conclusion that there is one element that is necessary to the success of any program which addresses the prevention, management and eradication of NIS. That essential element is a group of individuals that come together to form an advisory council to monitor and coordinate the efforts of the program and also to address those issues which require the commitment and dedication of agencies with some authority and responsibility to address resource and NIS issues. It is for this reason that the NIS work teams have identified the development of a Nonnative Invasive Species Advisory Council a priority action in the draft NIS Strategic Plan (pg. 14) and the draft NIS Implementation Plan (pg. 8 & pg. 13).

This project will establish the Nonnative Invasive Species Advisory Council (NISAC) with lead agencies of California Department of Food and Agriculture, U.S. Department of Agriculture, and California Department of Fish and Game and the U.S. Fish and Wildlife Service. Other CALFED agencies will be invited to participate, as will at least 4 others representing academia, environmental interests, water users and stakeholders. Kim Webb of the U.S. Fish and Wildlife Service will provide coordination for the NISAC activities through FY 2000. The mission of the Council will be to develop and maintain an organization which is responsible for the coordination and implementation of activities/projects that address the issues of NIS in the CALFED area of concern. In establishing this Council, it is recognized that the lack of such an organization will severely restrict the ability to address major issues of:

Leadership, Authority, and Organization

Coordination, Cooperation and Partnership

Funding and Resources

Enforcement and Compliance

While many needs are identified in the NIS Strategic and Implementation Plans, included in this

proposal are selected actions and tasks that will be completed by the Council. It is important to note that this project will be a "jump start" for this Council and that a major task will be to develop the support and funding necessary for the Council to continue work beyond FY 2000.

Linkages: NIS negative impacts extend into all CALFED Program Elements contributing to issues of water quality, water supply reliability, levee system integrity, water transfers, and watershed management. This project will be intricately linked with all of the CALFED Program Elements and CMARP. The Council will be responsible for recognizing and recommending projects/activities that will contribute to CALFED objectives most effectively. The need for this project is readily expressed in the Strategic Plan for Ecosystem Restoration (pg 3-11) ... the NIS issue stands to be the "single most likely impediment to shifting the ecosystem from it's present state to a new, more desirable state".... "It is imperative that ERP quickly put into action a robust, thorough program to reduce invasives to the lowest possible level, as stated in Goal 5, and to establish habitat conditions that favor native over nonnative species." The development of the NIS work teams and the draft plans has been a significant effort and the progress has been tremendous. The next logical step in the continuation and expansion of the effort to deal with the NIS issues is formalization of an Advisory Council with the pledged cooperation and support of essential lead agencies. This project proposes to carry forward with this effort and develop a self-sustaining Council that will provide invaluable assistance to the CALFED Program in their efforts to rehabilitate the ecosystem in the face of extensive NIS problems. All of the habitats, species and NIS stressors which are of concern to CALFED will be the focus of this project. The expected benefits will be a comprehensive, cohesive interagency response to increasingly devastating stressors that have been identified in CALFED documents as a major contribution to the decline of numerous species and habitats of concern. **The Primary Objectives:**

- 1) Develop a NIS Advisory Council
- 2) Identify elements of the Major Issues (see Project Description) the council will address to improve the efforts to prevent, control and eradicate NIS.
- 3) Develop recommendations for authorities and responsibilities of state and federal agencies for NIS regulations and enforcement.
- 4) Develop/provide pertinent NIS information to CALFED management/CARP in a timely and responsive manner to assist CALFED with ERP goals and to provide the public with NIS information, on-going activities and measures they can take to help.
- 5) Develop a Rapid Response Plan for new introductions of NIS.
- 6) Coordinate with other NIS organizations and entities
- 7) Develop support and funding for continuation of NISAC beyond FY2000

The Council will use an adaptive management approach to regularly evaluate outcomes and adapt future actions to integrate results of evaluations.

Funding request: \$50,000

Applicant Qualifications: Kim Webb, Lars Anderson, Nate Dechoretz and Alan Barracco have been contributing to the development of the CALFED NIS Program in coordination with NIS work team members. They are familiar with the CALFED goals and objectives and bring a wide range of experiences and expertise to the Advisory Council. As representatives of their respective agencies, they will contribute much to the advancement of the work to address NIS as part of the CALFED Program.

Executive Summary

By all estimates, the invasion of the San Francisco Bay-Delta region by non-native invasive species (NIS) is one of most serious obstacles to restoring the health of this important system. Plans for ecosystem restoration are at risk of repairing damaged estuarine habitat only to have it overrun with non-native species. This estuary is the most heavily and rapidly invaded estuary in the U.S. and arguably the world (Cohen and Carlton 1998). Of the nearly 250 species of NIS that now occupy the Bay-Delta region, many have already caused significant economic and ecological costs. Estimates of economic losses attributable to NIS in the U.S. during this century now exceed \$90 billion and may exceed \$100 billion over the next fifty years (Office of Technology Assessment 1993). These estimates apply proportionately to the Bay-Delta system as well. Ecological damage has been significant as well also with NIS being a contributing factor to the listing of many threatened and endangered species in the Bay-Delta region.

Most NIS invasions occur because of human activities and are not the result of natural range expansion. Furthermore a significant portion of these are not accidental and are rather intentional introductions horticultural or agricultural varieties or for purposes of fisheries enhancement. For example, of the 300 weed species in the western U.S., over 10% were outright escapes from agriculture or horticulture (Office of Technology Assessment 1993). Many more species have been unintentionally brought in with seeds or through other human activities.

The seriousness of the invasive species problem in the San Francisco Bay-Delta region has initiated direct action by CALFED in the form of a Strategic Plan for Non-native Invasive Species. The Strategic Plan for NIS formalizes and develops further many of the NIS related goals in the Strategic Plan for ERP. In particular, it makes prevention of future introductions of such species a top priority. It is this goal -- preventing future introductions -- that is at the heart of the current proposal. Eradication of most established species is nearly impossible, particularly with many plants and aquatic organisms. Even modest control measures are both expensive and technically difficult. The most effective strategy, either from the point of view of minimizing costs, maximizing ecosystem healthcontrol, or almost any other perspective, is to prevent introductions from the start.

The central objectives of this proposal is to educate industry members and representatives involved in the importation, sales, and distribution of live plants and animals. This includes aquarium and pet dealers, landscape contractors, nurserymen, aquatic plant dealers and "aquascape" contractors, seafood importers, bait dealers, and related industries. These industries have a high potential, and in many cases a past or even present track record of dealing with non-native species that have the potential to become pest species if allowed to escape or otherwise become established in the Bay-Delta Ecosystem. The central objective will be accomplished through in the five tasks outlined below that include several targeted activities that will minimize the probability of introduction and spread of NIS.

1) Workshops. To facilitate communication among industry, agencies and academia, a series of four workshops will be held to provide a forum for presenting the current problems posed by NIS

as well as the future risks. The target audience will be industry members and representatives from aquarium/pet trades, bait dealers, seafood market importers, aquascape and landscape industries and related industries involved in the importation, sales, and distribution of NIS. Information about the biology of these species will be presented as well as information about the pathways of transport. The goal is to discuss ways of minimizing the risks of both unintentional and intentional release of NIS and to gather industry input in the development of new methods to minimize these risks. There will be questionnaires distributed at the end of each workshop to help gauge its effectiveness and to provide the opportunity for input by the participants. This will also permit a basis for adaptive management that will feedback on the development of future workshops and information products.

2) Publications. To help facilitate transfer of information to a wide spectrum of industry members and representatives, we will develop a full page color brochure. This brochure will highlight pest species of concern, the impacts of these species on native taxa, the pathways by which these pests are most likely to get dispersed, and the best methods for preventing dispersal. The brochures are likely to be initially somewhat general with information about a wide variety of species and pathways. There will be subsections highlighting particular problem species and pathways of dispersal that are used by particular industries. Some brochures may be needed for specific industries such as the Asian sea food market. Additional publications will include a newsletter that includes information about upcoming workshops as well as highlighting new and emerging events of relevance to particular industries involved with NIS.

3) Video presentations. To more visually present the problem of NIS as a Bay/Delta-wide problem, we propose to produce a video that will highlight the problems that NIS create. This will be produced for distribution at workshops (see below) and for industry trade groups and meetings. The focus will be to present a visual description of the changes that exotic species have brought to the natural habitats of the Bay/Delta region as well how unintentional releases due to planting and culture practices contribute to the problem.

4) Public Service Announcements. To further distribute the message of halting the importation and spread of exotic species, we propose to develop a series of public service announcements aimed at informing the general public about NIS issues and the problems associated with the importation, sales, and distribution of NIS. The goal is a more general education campaign targeted at developing public awareness of the issues. This will involve developing audio and video segments for distribution to news organizations including local television and radio stations.

5) NIS Website: To develop an accessible central location for relevant information regarding the importation and distribution of NIS. This website, rather than being simply another site with species lists, will provide information about the mechanisms of NIS introduction as well as management solutions specific to the aquarium/pet trades, sea food markets, bait dealers, aquascape and landscape industries, and related groups. Additional information about upcoming workshops will be included as well as resource contacts available for outreach education and technical assistance.

EXECUTIVE SUMMARY

This proposal responds to a goal of the Ecosystem Restoration Program "to reduce negative biological and economic impacts of established non-native species. Two objectives from this goal are to present new introductions and to focus control where it is most likely to be effective. The proposal targets the zebra mussel, Dreissena polymorpha, which has caused millions of dollars of damage to water intake and delivery systems in the eastern United States from the Great Lakes and into the Mississippi drainage. Recently zebra mussels have been found in the Missouri River drainage and several live and dead mussels have been discovered in and on boats entering California.

The proposed approach is to implement a combination of public outreach and monitoring to, first provide information to educate the public about zebra mussels and the means by which they spread and, second to set up and operate an early detection system in the Central Valley, Bay/Delta and water storage and delivery systems.

The project will be coordinated through the CALFED Nuisance Introduced Species Task Force, the USFWS's 100th Meridian Initiative and the Coastal Committee of the Western Regional Panel of the federal Nuisance Invasive Species Task Force. The Project Manager will also work directly with introduced species coordinators in the states of Oregon and Washington.

The project is proposed for three years with a total request from CALFED of \$100,000. DWR will provide \$30,000 matching funds over the three-year period for staff support, reprographics and biological and chemical analyses.

Environmental impacts associated with the invasion of zebra mussels would be similar to those seen after the introduction of Potamocorbula amurensis in 1986, albeit more in the freshwater components of the Bay/Delta system and watershed. Like the asian clam, zebra mussels are filter feeders and remove planktonic organisms from the water column - organisms which form the basis of the aquatic food web.

Executive Summary

Purple loosestrife is a perennial plant from the European Continent which has invaded North America. It has moved extensively throughout the wetlands of the United States causing immense ecological destruction. It is now showing up in California in a number of small, but growing, infestations that are currently not under eradication or containment. It poses an aggressive threat to almost all the wetland and riparian habitats in the CALFED focus area. This threat is of greatest concern in the Sacramento-San Joaquin Delta where there are a number of threatened and declining species due to a multitude of environmental stressors.

The following project presents a general hypothesis, based on historic evidence and anecdotal observations, that purple loosestrife is present in multiple locations in the Sacramento-San Joaquin Delta system, and furthermore, that it can be eradicated by implementing an adaptive management program which addresses each infestation with the most appropriate management technique, as determined by CDFA personnel and outside collaborators. Over a three year period, the Integrated Pest Control Branch of the California Department of Food and Agriculture will carry out a series of tasks which will result in:

- 1) Exhaustive yearly survey of the Sacramento-San Joaquin Delta;
- 2) Local eradication of loosestrife in the Delta and other hydrological units;
- 3) Focused perimeter delimitation and survey of all loosestrife infestations in the CALFED focus area;
- 4) Training of agency personnel, working in and near the Delta, to recognize purple loosestrife and other aquatic nonnative invasive species; and
- 5) Education of the boating, water fowl hunting, and similar public citizenry.

Benefits and Linkage to CALFED: If loosestrife is allowed to invade the CALFED system, all of the following attributes will suffer major negative impacts: fish, threatened and endangered native wetland plants and wildlife, interface between farm land and water, recreation opportunities, productivity and nutrient cycling, water flow and quality.

The actions contained within this proposal are fully compatible with and flow directly from the Draft Strategic Plan for the CALFED Nonnative Invasive Species Program (NISP) and the Strategic Plan for Ecosystem Restoration (ERP StratPlan). The mission of the NISP is to "Prevent establishment of additional non-native species and reduce the negative biological and economic impacts of established non-native species"(pp 6,7,12, NIS StratPlan). The goals of the NISP Strategic Management Plan are:

- (I) *Prevention* of new introductions and establishment;
- (II) *Limiting* the spread and/or establishment; and
- (III) *Reducing* harmful ecological impacts; ecosystem alteration and displacement of native species (p 2, NIS StratPlan).

This project is fully consistent with Goal 5, of the Strategic Plan for Ecosystem Restoration Program (Table 5-1, ERP StratPlan). The ERP objectives identified for this goal include: Halt the introduction of invasive aquatic and terrestrial plants into Central California (Objective 6) (p 6, ERP StratPlan) and develop focused control efforts on those introduced species where control is most feasible and of greatest benefit (Objective 9) (p 6-7, ERP StratPlan).

Project Phases and Costs: This Directed Action Proposal is geared towards the prevention and eradication of purple loosestrife with a primary focus of detection and eradication in the Delta. This direct action will also cover detection and eradication of populations in the nearby hydrological units. The amount of the proposed direct action contract is \$201,306.00.

Because this directed action is tentative at this point, and doesn't address protection of the entire CALFED watershed, we submitted this proposal along with an augmentation for the full amount of an area-wide project. We broke the open solicitation proposal into two phases which separated the proposed contract for the directed action and the extra work plan to protect the whole watershed. These two phases were referred to as Phase I and Phase II. Although this terminology connotes a temporal sequence, it actually refers to a geographic separation which reflects distance for the Sacramento-San Joaquin Delta system and the funding limitation of the directed action.

Monitoring and Adaptive Management: Consistent with the adaptive management approach, the CDFA and cooperators will be continuously monitoring three different aspects of the project. Evaluation of the overall treatment and detection hypotheses and the yearly tactical integrated control plan will be ongoing throughout the duration of the project. Specifically, we will be monitoring: 1) treatment efficacy, 2) eradication efficacy, and 3) water adjacent to certain treatments.

Collaboration: There will be local collaboration and coordination with the following groups: County Agricultural Commissioners of Butte, Contra Costa, Fresno, Nevada, Placer, San Joaquin, Sacramento, Stanislaus, Shasta, Solano, Sonoma, Sutter, Tehama, Yolo, and Yuba Counties; local CDFA Integrated Pest Control Branch District Weed Eradication Biologists; local Weed Management Areas; and the CA Department of Fish and Game, CA Department of Boating and Waterways, US Bureau of Reclamation, US Fish and Wildlife Service, US Department of Agriculture - ARS Resource Conservation Districts, Local Watershed Groups and the California Native Plant Society.

Applicant Qualifications: The Integrated Pest Control Branch has a long history of weed management actions and has taken the lead in noxious weed prevention, detection, education, and control in California. The Weed and Vertebrate Program is largely focused on the detection and eradication of A-rated, listed State Noxious Weeds. The Branch has totally eradicated 13 weed species from the state. This group surveys the entire Delta in the Fall for Hydrilla (another serious aquatic weed) and thus has the specific experience to conduct purple loosestrife detection and mapping. The Hydrilla Program is very similar, but focuses on a specific aquatic weed of special concern. This program, which has similar components/structure to our proposed Purple Loosestrife Project, has shown great success. Hydrilla has been eradicated from nine out of 17 infested counties, and is nearing eradication in the others. The specific personnel who would run the project have vast knowledge and demonstrated experience to do the job.

CALFED BAY-DELTA PROGRAM ECOSYSTEM RESTORATION PROJECTS AND PROGRAMS

III. Executive Summary

a. Project Title and Applicant Name:

Introduced *Spartina* Eradication Project (ISEP)

California Coastal Conservancy

b. Project Description

The Introduced *Spartina* Eradication Project (ISEP) proposes to significantly reduce or eliminate the estimated 1,000 acres of introduced *Spartina* in the San Francisco Bay estuary. The Introduced *Spartina* Eradication Project (ISEP), is a regionally coordinated program with the primary objectives of preventing further spread of introduced *Spartina* species to the North Bay and Delta, preventing its introduction to new restoration projects and halting the degradation of CALFED priority habitat. This proposal outlines the specific initial strategic goals of the demonstration phase, year one, of ISEP.

c. Primary Ecological Objectives

- Prevent introduced *Spartina* from spreading to the North Bay and Delta negating the effects of millions of dollars spent on priority habitat restoration including those proposed in Suisun Bay and Marsh Ecological Unit, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Units.
- Reduce the negative biological and economic impacts of established non-native species. (CALFED funding priority #5)
- Benefit migrating neotropical birds, aid the recovery of four special status species including the endangered California clapper rail, California black rail, salt marsh harvest mouse, and one Delta special status plant species, soft birds-beak.
- Reduce a species of Invasive Aquatic Plants, a CALFED identified stressor on the Bay Delta region.
- ISEP addresses CALFED objectives regarding Bay-Delta Aquatic Food Web/Ecosystem Processes. ISEP will prevent and reduce degradation to unvegetated tidal mudflats, sites of important secondary productivity.

ISEP builds on an existing foundation of public support and involvement including the California Department of Fish and Game and the United States Fish and Wildlife Service. ISEP includes comprehensive monitoring and public education components.

d. Budget Costs (Year I) and Adverse Third Party Impacts.

Total Cost Estimate \$ 375,000.00 Request from CALFED \$250,000.00
 California Coastal Conservancy Contribution \$125,000.00
 In-kind contributions \$293,000.00

Adverse third party impacts include temporary reduction or closure of public access during control operations. This can be addressed with advance public notification and outreach.

e. California Coastal Conservancy (Conservancy) qualifications:

Applicant Qualifications: The California Coastal Conservancy was created by the Legislature in 1976 and given flexible powers to work in partnership with public agencies and non-profit organizations to protect and preserve coastal and San Francisco Bay resources. The Conservancy has completed more than 400 projects and is currently participating in over 100. It has helped to preserve and/or enhance more than 50,000 acres in tidal and freshwater wetlands, coastal streams, watersheds, and farmlands. It has a staff of 48 which includes environmental planners, attorneys, accountants, and other administrative and clerical support staff.

f. Local Coordination and Support

The Conservancy will administer contracts to the following agencies for the specific components of ISEP (coordination / mapping, monitoring and assessment / research / operations). Team *Spartina*, an interagency advisory panel, will convene biannually to advise, review reports and progress.

California Coastal Conservancy: Project administration, oversight of project and field operation coordinators.

San Francisco Estuary Institute (SFEI): Mapping/monitoring/assessment.

USDA Agricultural Research Service, Dr. Lars Anderson, and U.C. Davis, Drs. Don Strong, Debra Ayres: Research.

East Bay Regional Park District, Don Edwards Nat'l Wildlife Refuge, Alameda County Public Works (Flood Control), Bay Area Mosquito Abatement Districts, Bay Area County Commissioners (Sacramento, Solano, Contra-Costa, Alameda, Santa Clara, San Mateo, San Francisco, Marin, Sonoma, Napa), California Dept of Fish and Game, USFWS, Alameda Dept of Agriculture, Benecia State Rec. Area: Operations/Field Control. Additional public and private stakeholders will be added to the Operations list of agencies as the project expands.

g. Monitoring and Data Evaluation

SFEI will develop a three year monitoring and data evaluation program. Phase I will include monitoring and mapping of existing populations /new outlying populations and sampling for control efficacy. Each research task includes additional sampling/data collection/protocols and data evaluation. ISEP participants (coordination, mapping, research, operations) will provide annual summaries to the project coordinator for the annual ISEP Status Report. Team *Spartina* will review monitoring and data evaluation.

Executive Summary

Invasion of shallow water habitats by non-native plants causes great economic and ecological damage. Prevention and control of the invasions is patently desirable. The variable nature of the invasive species and their complex relationship to land use calls for coordinated, comprehensive control efforts throughout government, the private sector, and the public. The successful control efforts will require broad communication of practical, science-based recommendations to prevent and control the invasions. The proposed guidebook would make such information easily accessible to all interests.

Project Scope

The proposed guidebook would provide practical information for local control of the highest priority species of non-native invasive plants of shallow water habitats of the landscape of the Bay-Delta watershed. The guidebook will focus on species that most threaten the beneficial uses of the waterways and for which there exists adequate information to assure successful prevention and control

Project Cost and Schedule

The proposed guidebook would cost \$75,000 and take one year to produce.

Ecological Objectives

The final guidebook will perhaps address perhaps 15 - 20 species of invasive non-native plants that are selected based upon the severity of their threat to shallow water ecosystems and the amount of information that can be provided to minimize this threat through local prevention and control efforts.

Much of the scientific information about the prevention and control of non-native invasive plants in the Bay-Delta ecosystem exists in the minds of local and regional experts. There is a need therefore to assemble these experts to garner their advice and help in planning and creating the guidebook. The involvement of the regional community of experts will also improve the authority and practicality of the guidebook. The Project Director and the Collaborator will assemble the experts and compile their technical input.

In order to maximize the content of the guidebook, it will be necessary to minimize its production cost. These costs are best minimized by publication of the guidebook on-line. The guidebook will be formatted in PDF and HTML for ease of on-line use and downloading entirely or in part. On-line publication could occur through multiple web sites, including at least the SFEI web site and CERES. There will be an effort to advertise the guidebook in government offices, local marinas, and other centers of waterway management and use.

Coordination with Other Programs

The proposed guidebook is envisioned as part of a growing effort to address the economic and ecological threats of invasive plants in shallow water habitats of the Bay-Delta ecosystem. For example, the design of the guidebook and the selection of expert

contributors will be informed by the Shallow Water Work Group of the Interagency Ecological Program (IEP), the Bay Area Regional Wetland Monitoring Program currently being developed through SFEI, the Team Arundo and Team Spartina proposed for funding by CALFED, the Bay-Delta NIS workshops and related science being planned collaboratively by SFEI and EPA Region 9, and the ongoing research by the Aquatic Weed Science Program at UC Davis. The Project Director and the senior Collaborator are leading participants in these other programs and projects.

Applicant Qualifications

The Non-native Invasive Species Work Teams of CALFED have selected the Project Director and Collaborator. The Project Director is the Senior Wetlands Scientist at the San Francisco Estuary Institute, and director of SFEI's Watersheds Program and GIS. The senior Collaborator is Research Leader of the USDA-ARS Aquatic Weed Research Laboratory at UC Davis. Both scientists have abundant experience in the leadership of ecological research and technical writing teams.

Adverse and Third Party Impacts

There will be no adverse or third party impacts resulting from this project.

Monitoring and Data Evaluation

Monitoring data for this project will be restricted to counts of visits to the on-line guidebook at each of two web sites. It is also expected that the guidebook will provide names and addresses of contact persons for comments and suggestions about the guidebook.

1. Executive summary

We propose a research project on the effects of the introduced clam *Potamocorbula amurensis* on the food web supporting several fish species of concern of the San Francisco Bay-Delta estuary.

The influence of introduced species is a theme that appears frequently in documents of the CALFED Ecosystem Restoration Program, and with good reason: *introduced species may limit the degree to which the estuarine ecosystem can be rehabilitated*. Although actions to reduce the influence of introduced species would be preferable to research, we lack the understanding needed to identify what actions might have what beneficial effects. Thus, research on introduced species will prove essential to rehabilitation of the estuarine ecosystem.

CALFED's rehabilitation activities are to rely on natural ecosystem processes. If these processes have been altered by introduced species, then both the scope for rehabilitation and the effectiveness of rehabilitation actions may be drastically altered. Therefore it seems essential to know how key introductions have altered the ecosystem, and how they may influence ecosystem processes.

The estuarine ecosystem has seen numerous introductions. Within the brackish subtidal estuary, the most significant introduction in recent decades has been that of the clam *Potamocorbula amurensis*. This clam was introduced in 1986, became abundant throughout the northern estuary in 1987-88, and has remained abundant in spring-fall of most years since. It has caused a number of major changes in the lower foodweb, and data on abundance of several fish species indicate declines concurrent with the spread of the clam. However, it is still unclear whether changes in fish abundance can be attributed to clam effects. It is also unclear how the altered foodweb might affect the success of rehabilitation actions in the estuary.

CALFED documents justifiably emphasize rehabilitation actions in preference to research. However, for fish species of concern in open waters of the estuary, few actions have been identified, and none with much certainty about their effectiveness. The reason is the lack of knowledge about the function of this ecosystem, the likely outcome of different, alternative actions, and the role that introduced species have in limiting options for rehabilitation. Our proposed research will fill key gaps in knowledge and help to suggest ideas for actions that might result in improvements for these key species.

CALFED Ecosystem Restoration Program documentation strongly supports the need for research on effects of introduced species on the estuarine foodweb. First, the Strategic Plan for Ecosystem Restoration includes as Goal 5 prevention of establishment of non-indigenous introduced species, and reducing their negative biological and economic impacts, but the negative impacts of introduced species in the estuary have yet to be determined. Second, according to Strategic Plan Goal 2, the ecosystem is to be

rehabilitated through the use of natural processes to support native species. However, we understand very poorly the capacity of the estuarine ecosystem to support natives, and how the numerous introductions have altered this capacity.

The need for research on the effects of introduced species is spelled out repeatedly in CALFED ERP documents. For example, "...it is important to initiate an early program that: ... develops a better understanding of how non-native species affect ecological processes and biological interactions, ..." (Strategic Plan). "A major obstacle to solving problems of estuarine productivity is our poor understanding so solutions will have to come from research and monitoring ..." (ERP Vol. 1 p. 46). "(The reduction in estuarine foodweb productivity) implies a limit on the extent to which Bay-Delta fish populations can be restored unless creative solutions can be found to increase foodweb productivity" (ERP Vol. 1 p. 98).

The creative solutions called for in the ERP have not yet been found, to our knowledge. Thus, the need for the research that we propose has been clearly indicated by the CALFED ERP, and is clearly supported by the current state of scientific knowledge about the estuarine foodweb.

The objective of the proposed research is to answer the following questions:

1. *How has the introduced Asian clam *Potamocorbula amurensis* altered the feeding environments of young fish species of interest (longfin and delta smelt and striped bass)?*
2. *How has *Potamocorbula amurensis* affected the production rate of food, both native and introduced, for young fish in the Bay/Delta, and could production be increased?*

The three species of fish were chosen not only for their importance in restoration of the estuarine ecosystem. They also provide a contrast in life histories and likely responses to environmental conditions and introduced species, particularly the clam *P. amurensis*. This contrast should enable us to distinguish among responses to these influences.

We will use analysis of existing data and relatively simple simulation models to maximize the knowledge gained. The proposed research will comprise 3 tasks: 1) *Analysis of existing data* on co-occurrence of fish and their prey, and on the inputs of various sources of organic matter to the estuarine ecosystem; 2) *Modeling* to set up a framework for the analyses and experiments, and to investigate the limits that system productivity places on increases in fish populations; and 3) *Synthesis* of the overall results into a comprehensive and detailed description of the current status of the food web and likely impediments to rehabilitation.

This research program will produce the most comprehensive assessment to date of the effect of *P. amurensis* on the food web and on key fish species. Reports will detail the role of *P. amurensis* in the foodweb, its effects on the fish species of interest and the

estuarine ecosystem as a whole, and the potential for lifting limits on system productivity or population abundance within the system as it now exists.

This research is being proposed by Dr. Wim Kimmerer, who has extensive experience in all aspects of the proposed research in the Bay-Delta estuarine ecosystem and elsewhere. His experience as a member of the Core Team for the ERP Strategic Plan gives him the perspective to ensure that this project is not merely an academic research project, but that it has direct relevance to the ERP. He will be assisted by a San Francisco State University graduate student who will develop a master's thesis based on the work described here.

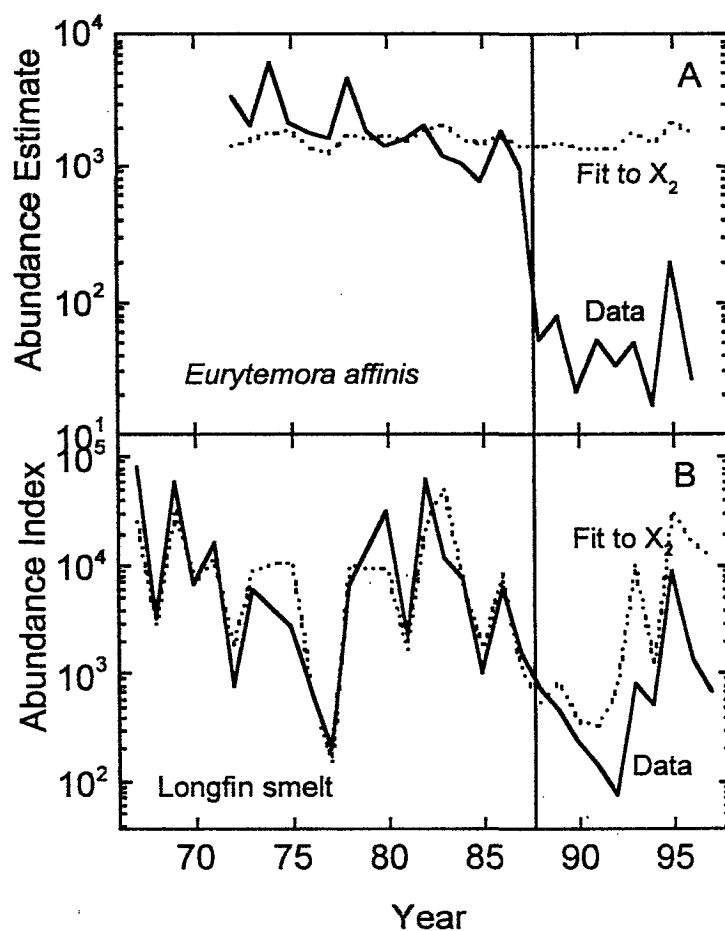


Figure 1. Time series of abundance data and data fit to a linear model in X_2 . The vertical line gives the time of the spread of the Asian clam.